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ABSTRACT

This publication provides guidelines for the operation of an elementary school (K-6) science program curriculum. The report describes the science program which was developed and is in operation in the Montgomery County Public School District (Rockville, Maryland). An emphasis of the program is to maintain continuity between all levels of the school science curriculum. To provide this, an overview of the entire science program is presented, along with sections listing instructional activities, science materials, textbooks, and equipment for each of the three two-year "frameworks" which make up the total program. Appendices list annotated library titles under appropriate content areas as well as library resource books, textbooks, pamphlets, and teacher's guides which are most helpful to instructors in the program. (CP)

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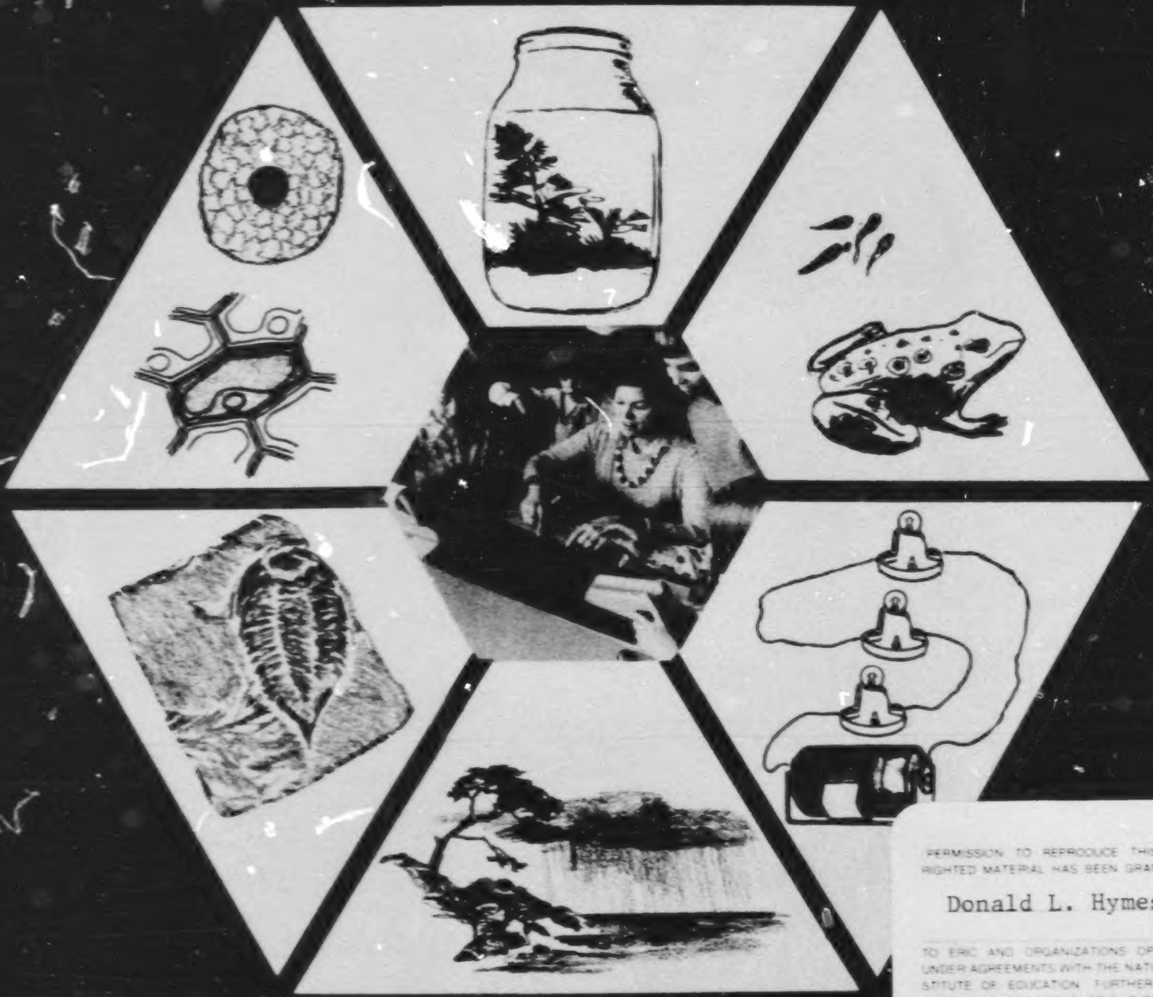

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SE 020 239

MONTGOMERY COUNTY PUBLIC SCHOOLS, ROCKVILLE, MARYLAND
HOMER O. ELSEROAD, SUPERINTENDENT OF SCHOOLS

BULLETIN No. 276

Adopted by the Board of Education - February 12, 1973

Montgomery
County
Public
Schools

The Goals of Education

The goals of education for the Montgomery County Public Schools are set forth in this statement of public policy to guide the school system in developing, implementing, and improving educational programs for its students. This statement outlines those goals considered by the citizens of the county as most important for the education of their children in public schools and for which the citizens will hold the school system responsible and accountable.

The school system has the primary responsibility for some of these goals. For others, it shares that responsibility with the home and other community institutions.

The extent to which these goals can be realized will depend upon the endorsement by and continuing commitment of the school system staff, students, parents, and the community. With broad endorsement and wide support, the Montgomery County Public Schools will continue its development to serve its students and community in the most effective way possible.

Education is a process that encompasses the total experiences of each individual throughout a lifetime of formal and informal learning. The school program, as a keystone in this process, should provide opportunities and encouragement for students to acquire knowledge, to explore ideas, to ask questions, and to seek answers that will lead to sound and useful conclusions.

The probability of success motivates students to learn. Each school must create a program and maintain a climate in which every student has opportunities for success. Each individual is unique, and the school shall encourage that uniqueness. The school should help the student understand his values and the values of others.

The school program, while developing the skills of learning, should be based on the study of broad human concerns, flexible enough to deal with changing concerns and at the same time related to the needs, interests, and concerns of each student. The program should offer opportunities for decision-making. It should help the student develop the capacity to learn throughout his lifetime, to respond to and understand other human beings, and to accept full responsibility for the results of his actions.

Therefore, the Montgomery County Public Schools dedicates itself to provide the opportunity, encouragement, and guidance to make it possible for every child to attain the following goals of education

ACADEMIC SKILLS

The fundamental responsibility of the school is to develop programs that enable each child to acquire those skills basic to all learning. The achievement of all other goals depends upon the success of the school in ensuring that each student, according to his own abilities, attain the following basic skills:

- **Reading**: The ability to read and comprehend written material and relate it to other knowledge
- **Composition**: The ability to write with precision, clarity, and acceptable usage, whether to inform, inspire, or persuade
- **Listening and Speaking**: The ability to listen attentively and with understanding and to speak with confidence and effectiveness, whether from written material or extemporaneously
- **Mathematics**: The ability to perform computations, to solve common problems of mathematics and logic, and to understand the structure of mathematics so it can be a useful tool in daily living
- **Study**: The development of basic study skills so that he may acquire knowledge efficiently
- **The Arts**: The development of some of the basic disciplines and skills in the performing and creative arts to be used throughout his life for communication, expression, and enjoyment
- **Observation**: The ability to identify and differentiate elements of the world around him as they are useful in personal, academic, and artistic pursuits.

PHYSICAL DEVELOPMENT

Each person matures physically at a different rate and possesses differing capabilities. The school has the obligation to help each student:

- understand the biological functioning of his body
- make the best both of physical talents and limitations
- develop good health habits, skills, and interests to maintain his body in optimum condition throughout his lifetime

INTELLECTUAL DEVELOPMENT

In addition to acquiring academic skills, each individual should develop his intellectual capabilities to the fullest extent possible. Therefore, the school will encourage each pupil:

- to think creatively
- to reason logically
- to apply knowledge usefully
- to deal with abstract concepts
- to solve problems

(continued on inside back cover)

(continued from inside front cover)

THE INDIVIDUAL AND SOCIETY

Every person must learn to live in a society. The school must help each student develop an understanding of man and of how the individual depends upon others and they on him. This requires that each student gain:

- knowledge of himself and the characteristics, needs, and desires he shares with others
- sensitivity to others and their ideas, and the ability to act responsibly in various situations
- the ability to function productively as a member of a group
- familiarity with the legal, moral, ethical, and cultural heritages of his and other societies
- knowledge of the various political systems and philosophies of the world

SCIENTIFIC UNDERSTANDING

Man must exist in the natural world. The school must help each student understand nature's impact on man and man's impact on nature. This requires that each student gain:

- knowledge of natural phenomena and their effect on man
- understanding of scientific advances and their part in modern technology
- understanding of the scientific method
- appreciation of the ways in which the application of scientific principles can improve the quality of life while preserving the natural order

AESTHETIC EXPRESSION

Man, to realize his full potential, must be able to sense and appreciate beauty in the world around him, whether created by nature or by man. The school must help each student gain:

- knowledge of the nature of the creative and performing arts
- experience with a wide variety of art forms
- a perspective for developing his own aesthetic criteria and tastes
- understanding of the contribution of the arts to human communication

CAREER DEVELOPMENT

Productive and satisfying work enriches man's life; and with increasing leisure time, many people will use various occupational skills for avocational purposes as well. The school must help each student gain:

- knowledge and appreciation of the [illegible] variety and interrelationships of occupations in mode[illegible]ty
- opportunities to explore potential [illegible]ations in relation to personal aptitudes and interes[illegible] restricted by stereotypes of sex, race, or socio-economic level
- the knowledge, skills, and abilities that enable him to secure satisfying employment, embark upon further training and education in a chosen career field, and adapt occupational talents to changing job demands and opportunities

COMMITMENTS

The Board of Education and the staff of the Montgomery County Public Schools must create and maintain an educational environment that promotes the attainment of these goals by all students. Toward this end, therefore, the public schools make the following commitments to the citizens of Montgomery County:

- *To attract and retain the most qualified and best trained staff possible through dynamic programs of recruitment, supervision, and continuing inservice training and staff development opportunities*
- *To develop and implement a comprehensive and flexible instructional program to achieve the aforementioned goals and to provide the facilities, materials, and equipment needed to enhance the effectiveness of the program*
- *To evaluate the effectiveness of the instructional program continuously, and regularly report the findings to students, parents, staff, and the community*
- *To adopt new and different approaches when it is determined that they will contribute more effectively to the fulfillment of the goals*
- *To encourage a continuing dialogue with the entire community, making every effort to communicate needs and achievements, and to be responsive to the needs and aspirations of the school community*
- *To utilize facilities and staff, in cooperation with other agencies, in the development of preschool, community school, and adult education programs that will meet the continuing educational needs of all citizens*
- *To provide an accountability procedure for informing county citizens of the objectives and costs of their school system and of reporting periodically on the educational investments made with their tax dollars.*

TEACHING SCIENCE
IN THE
ELEMENTARY SCHOOL

Bulletin No. 276

Montgomery County Public Schools
Rockville, Maryland
Homer O. Elseroad
Superintendent of Schools

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Rockville, Maryland

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PREFACE

This course of study provides guidelines for implementing the day-by-day conduct of a school's science program. It articulates a K-6 science program for Montgomery County Public Schools and will be useful to program planners, administrators, teacher specialists, and classroom teachers. The science content, suggested organizational patterns, and developmental sequences have been classroom tested by teachers experienced in working with elementary school children.

The material is based upon experiences of teachers and represents a spectrum of viewpoints drawn from the research, national authorities, and leadership in the field of science education. It defines a science format that has sequence, continuity, and sufficient depth to allow a wide range of adaptation to fit the inherent variability in individual schools. Program planners and principals will find Section II "An Overview of the Science Program: K-6" most useful. Emphasis is placed on describing a continuity and sequence that implies need for maintenance in efforts to evidence a viable program. Guidelines are presented that give a set of parameters for science programs in the schools. This section lists selected instructional materials and relates them to broad content areas. Classroom teachers and teacher specialists using this section will find that it suggests ways to carry out a classroom program for science. The parameters described here are a base of operation which encourage flexibility and creativity in teaching modes and classroom organization.

The classroom teacher will find that while most of the material is of general interest, he or she will utilize some sections more than others. In Section IV the teacher is asked to make use of the "Elementary Science Frameworks" which are models of science activities or lessons. The models incorporate selected outcomes from the Program of Studies, a spectrum of science activities, related performance objectives, and suggestions for alternative science activities. The selected outcomes from the Program of Studies are an outgrowth of the Goals of Education printed on the inside covers of this document.

A major purpose of this bulletin is to give the teacher assistance in his or her teaching of science and to the pupils in their learning. It is intended to identify tools for the teacher in a format of information and guidelines that can be used to teach about the concepts and processes of science; it is suggested that pupils will effectively learn science by their involvement and interaction in selected activities. This activity-oriented program will enable the school to "help each student understand nature's impact on man and man's impact on nature" as set forth under Scientific Understanding in the Goals of Education. It is expected that science, viewed as a content area, will serve as a vehicle for reading opportunities as well as an avenue for application of language arts skills in writing, speaking, and graphic expression in the school's responsibility to develop academic skills also outlined in the Goals of Education. Appendix A is a listing of library science books for children. The lists are correlated with the parts of the program; teachers will find this section helpful, especially in meeting individual needs of children and enhancing reading activities growing out of the science lessons. Children should have opportunities to write stories, make drawings, and communicate with the teacher and other children about their observations, measurements, and other findings based on their direct experiences with science.

Classroom teachers and teacher specialists can make use of that part of Section I entitled "Support Systems for Teachers." The interaction of teachers and the teacher specialists provides a baseline for continuing implementation. Classroom teachers discover avenues for channeling questions and requests in this section. Teachers and principals identify mutual concerns in the part of Section I titled "Organizing for Instruction." All areas of the curriculum are best accomplished through good planning but this is especially true in a materials and activities oriented program.

The principal and his faculty should note in Section II "An Overview of the Science Program: K-6," a design and sequence for elementary science. It is presented by grade-level bands in order to correlate instructional objectives, planning, and instructional materials with specific substantive topics and broad content areas.

The chart, "A Design and Sequence for Elementary Science: K-6," on page vii provides a broad overview of the major conceptual schemes and substantive topics which should serve as guidelines for the selection of classroom activities by teachers. A balanced treatment of concepts from the physical, biological, and changing universe areas of science is presented. A set of substantive topics is sequenced to establish priorities for the content at each grade level in the elementary science program.

Program planners and principals will find in Section III a capsule description, "School-Wide Planning for Curriculum and Science Materials, Textbooks, and Equipment," which they can use as baseline information about individual components of the science program.

The section "Planning and Organizing for Teaching Science" is directed to the classroom teacher. It suggests ways in which children may be grouped by the teacher as he or she organizes the classroom to facilitate learning processes.

This set of guidelines is based on the premise that every teacher of young children should present a well-balanced program of science suited to their interests, needs, and maturity. Children experience many contradictions, conflicts, and tensions. Science helps to offer a world in which they can be resolved or at least minimized. The activity-oriented science program provides for the child a world of manipulation, observing events, and sharing ideas about their surroundings; they learn to see themselves as able to solve problems by using their senses, collecting information, and getting an answer. They build a set or frame that grows out of actions which they take; they learn that actions speak louder than words. They find out that they learn by doing.

What happens in the classroom — be it inside four walls, in an open pod, on the school grounds, or at a field trip site — is a mix of teacher, children, and materials for instruction. Children learn by doing; they learn from example; they learn best when their interest is sparked and when their appetite is whetted. Science is a particularly useful content area for children and their teachers because it involves doing; it presents a stage of curiosity upon curiosity; it is about the physical and biological world; it is so varied that its very nature speaks of excitement and fun in learning. Finding out through exploring, measuring, observing, and then recording; and reading, talking about, explaining, and concluding put science activities for children in a quite "real to life" frame that serves to promote their literacy in science.

A DESIGN AND SEQUENCE FOR ELEMENTARY SCIENCE: K-6

	MAJOR CONCEPTS OF SCIENCE					
	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are interdependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
K	Force and Motion	Properties of Matter	Environmental Differences	Needs and Processes of Living Things		
1	Forms of Energy	Forms of Matter	Effect of Environment on Living Things	Reproduction	Forms of Life	Earth and Daily Changes
2	Energy Changes	Matter and Motion	Environmental Conditions for Life	Life Cycles	Extinct Life	Movements of Earth and Moon
3	Radiant Energy	Structure of Matter	Environments and Related Living Forms	Classification of Living Things	Environmental Changes	Solar System and Change
4	Energy and Motion	Chemical Changes	Exchange Between Living Things and Environment	Environment and Reproduction	Living Things and Environmental Changes	Celestial Bodies and Motion
5	Energy, Force, and Motion	Conservation of Matter	Green Plants and Radiant Energy	Cells	Living Things and Time	Celestial Bodies and Change
6	Energy Systems	Matter and Energy in Nuclear Reactions	Adaptations of Living Things	Genetics and Characteristics	Genetics and Change	Radiant Energy of Stars

ACKNOWLEDGMENTS

Science in the Montgomery County Elementary Schools was begun in the summer of 1972 as an initial effort by the Department of Curriculum and Instruction to articulate a K-6 science program.

The teachers involved were Arthur Beagle, Katherine Foti, and Willard Edmiston; the science teacher specialists were Clifford Springer and Sylvester Roberts. Their's was a monumental effort that resulted in a working draft that was used by teacher specialists during 1972-73.

During the summer of 1973 Jack Hahn and William Peacock worked with Clifford Springer on an extention and revision of the document; they were joined by Katherine Foti, Antonio Almario, Willard Edmiston, and Samuel Poole. Sylvester Roberts assisted for the major part of the curriculum workshop.

The cooperation of area administrative offices in the assignment of these persons to the science curriculum development workshop was instrumental in the successful completion of the writing task.

Curriculum documents do not stand alone; they are the result of growth and development and are the product of change. This document has its roots in the far reaches of the school system. The sum of its parts add up to more than the whole.

Through the years, a cadre of dedicated men and women have made their contributions. Some have moved to other positions but many remain to carry on with the ideas that began as seeds of a science program at an earlier time.

It is particularly important to recognize Ethleen Daniel, Dr. John Pancella, Dr. Charles LaRue, Edmund Burke, and Edmund Hoffmaster as direct contributors to the substance of this document.

During the summer of 1974 the following teacher specialists participated in a final revision of this document, Teaching Science in the Elementary School: Eugene Haines, Joseph Scallion, Barbara Beachley, and Elizabeth Kilgore.

The Division of Processing Services provided invaluable service in the cataloging of items in Appendix B. A measure of credit belongs to those who contributed to the compilation of the 1969 Elementary Science: A Booklist of Approved Library Titles. Sylvester Roberts deserves credit for updating and selecting titles for this document.

1

Science Program in the Montgomery County Elementary Schools

I. SCIENCE PROGRAM IN THE MONTGOMERY COUNTY ELEMENTARY SCHOOLS

INTRODUCTION

Science literacy for the school population is a continuing goal of science education. Substantive topics organized within broad science content areas and dealing with the data of science, the processes of science, and applications of science serve in MCPS as a basis for a science curriculum that aims toward that goal.

The foundations for scientific literacy cannot be left to chance contacts with bits and pieces of science instruction. We are faced with giving a realistic introduction to scientific work that can be the cornerstone for scientific careers for some of our students; meanwhile, we are faced with teaching science for a great majority who will be citizens of a free society and who will require a degree of scientific awareness that will permit them as citizens to be supportive of the work of scientists.

The science curriculum in the early years (K-6) should generate scientific awareness through involvement and internalization of the general nature of the scientific enterprise. Students should be exposed to science activities where they use some of the basic tools of research such as observation, measurement, recording, and communicating; they should learn how it happens that useful contributions tend to arise out of the selection, organization, and utilization of data that yields information -- how, what, or why?

The MCPS Program of Studies has been generated in this spirit. This document, Teaching Science in the Elementary School, is a program support document for use in interpretation and implementation of the science program in the schools. In the hands of teachers, principals, and other decision makers, this document is one means of promoting the fundamental goal of scientific literacy.

The science content and suggested organizational patterns or sequences proposed for use in MCPS are the results of the interaction of classroom teachers, science specialists, and science supervisors plus the works of scientists and scholars of national and international stature. The lessons and activities have been prepared with their help and have been tested in classrooms with teachers experienced in the methods and strategies of elementary school teaching and learning situations. Throughout science education there has been a trend toward narrowing the whole of science into few rather than many content areas. The MCPS science program reflects this trend.

The "processes of science" are now more regularly considered when organizing for teaching. Greater attention is being given to how children learn what we ask them to and how children move from one level or developmental stage to another. Performance objectives and task-oriented activities for pupils have provided increased direction to a total science program.

The framework provided will help put a handle on the day-by-day operations for the classroom teacher in carrying out a science program. What to teach: When and how? -- continue to be central in making choices for science instruction. The following pages are an attempt to provide direction for ways of implementation of a program in science. The intent is to promote activities that will result in the acquisition of knowledge about science, skills in science, and understanding of the investigative nature of science (scientific literacy).

THE CLASSROOM TEACHER

The classroom teacher continues to be the key person in the instructional process. His or her knowledge of the subject or content area, methods of teaching, and attitude about science are critical if the student is to enjoy a successful science experience. Equally important is the teacher's recognition of the strength of each student and the selection of procedures that will help the student develop those strengths and acquire new strengths.

A major responsibility of the teacher is to plan a science program that will involve the student in both the processes of science and in science reading activities. The processes of science are best learned by engaging in those processes. At the same time reading helps to reinforce concepts and to inform the student of discoveries and concepts. This document reflects an emphasis on the investigating through activities aspect of science; the teacher should understand that a balanced science program encourages both investigating and reading activities.

Selection of appropriate instructional materials is also the responsibility of the classroom teacher. Selection should be based on the goals of the teacher as they reflect the school's science program and the needs of each student. Materials need to be updated periodically. The teacher should be aware of available materials that are suitable to support the science program. The school staff should regularly assess the science materials as to quality, quantity, and schoolwide effectiveness.

The classroom teacher also has the responsibility for grouping the students for instruction. Grouping is a continuous process that takes into consideration the student, the materials available, and the purpose of the lesson. Differences in achievements, interests, and learning styles require the teacher to group and regroup the students. The teacher might elect to work with small groups, set up work centers, or have some students involved in reading and research assignments while others are working with selected science activities. The teacher should also be aware of the desirability of having students working on individual projects and assignments. The purpose of a given lesson might best be achieved by working with the total class or some form of grouping. Grouping needs to be flexible and purposeful.

The teacher who chooses to make a difference will do so, and the tasks stated can be accomplished only by the classroom teacher. If effective science teaching is to be accomplished, the teacher must be constantly aware of his or her role and be willing to modify methods of teaching to meet the various and changing demands of the students, collectively as well as individually.

SUPPORT SYSTEMS FOR TEACHERS

Teachers should be encouraged to make use of all available resources in planning and implementing their science activities. The people, materials, and activities described here are examples of resources that are available.

Area Based Teacher Specialist

To promote a well-planned science program for children in the MCPS, science teacher specialists are prepared to help at all grade levels. Serving in an advisory capacity to the principal and his or her teachers, the science specialist can assist in planning an effective schoolwide program.

The science teacher specialist is available to assist the classroom teachers in organizing their classrooms for improvement and enrichment of science experiences. The specialist can assist in the selection of activities appropriate for each grade level; he or she can identify materials, books, and texts which are available to teachers and which are most appropriate to the individual class. The specialist is prepared to advise in the implementation of new programs and to assist in the promotion of an ongoing science program in each school. Science teacher specialists are encouraged to recognize existing programs and to work with the school toward its individual or unique program.

When schools identify special needs, teacher specialists are available to conduct workshops or in-service activities in that school. The principal and grade level or science program representatives should share in planning the workshops or in-service activities so they may best be adapted to the individual school program.

Teacher specialists can also assist program improvement by planning, developing, and conducting in-service training programs on an area-wide basis. These in-service training courses provide an opportunity for teachers interested in building or increasing competencies in science by making them aware of new trends, programs, and curriculum materials in the field.

Staff Development In-service Courses

In-service training courses by teacher specialists are offered during the fall, spring, and summer. The following is an example of one course offering developed by teacher specialists for an area in-service training course:

SC-09 Contemporary Programs in Elementary Science

A course to enable elementary teachers to acquire an operational understanding of the CIS (Concepts in Science), ESS (Elementary Science Study), EIS (Experiences in Science), SAPA (Science - A Process Approach), SCIS (Science Curriculum Improvement Study), and COPES (Conceptually Oriented Program in Elementary Science) programs. Participants will have the opportunity to examine materials and equipment for each of the above programs and to work directly with small groups of children in a classroom setting. Participants will be encouraged to relate these instructional programs to their individual school needs and available resources.

Supplemental Programs

Spacemobile Program -- NASA -- Goddard Spaceflight Center

As the K-6 science program continues to develop, special services such as the NASA spacemobile are conducted by a qualified representative from NASA. He conducts activities, presents models, and explains and demonstrates the use of current instruments used for collecting data in outer space.

Planetariums -- Study the Changing Universe

More programs are being conducted in planetarium science with a stationary starlarium at Brookmont and portable planetariums in several of the administrative areas. These planetariums are used by the science specialist adapting the programs for Grades K-6. The portable planetariums can be set up in any school which has a room that can be darkened and can comfortably and properly house a learning group in a teachable mode.

School Grounds and the Science Program

This program can be a K-6 program or it may be used on an individual grade level. The science teacher specialist can be called upon to organize and conduct these special activities through the individual school principal and teachers. School Grounds as a Site for Inquiry is a resource unit of study intended for those schools who want to build a science program with some emphasis on their school grounds.

Supplemental Activities for Students

100 Invitations to Investigate (Harcourt, Brace and Javanovich)

This supplemental kit (CIS) provides upper elementary students with an opportunity to work on experiments apart from their regular classroom work. Each activity is written separately on durable cards listing materials needed which can be found in the home or classroom and instructions on how to conduct the experiment. These investigations promote individual enrichment as well as building concepts learned in the classroom.

This kit is available in most elementary schools; if not, it may be secured through the area teacher specialist.

Investigations in Ecology (Merrill)

A set of 70 plastic cards with investigations dealing with the environment. An activities oriented program that places emphasis on ecology -- the study of the way the world "gets it together." Ecological studies presented revolve around variation, interaction, change, and the phenomenon of continuum. The boxed program is accompanied by A Guide to Learning: Investigations in Ecology (1972).

This kit is available in most elementary schools; if not, it may be secured through the area teacher specialist.

Related Curriculum and Programs

Environmental Education

Environmental studies offer excellent opportunities to develop investigating skills. Many activities in the K-6 science curriculum support the concepts of environmental studies. The problems involve many variables, interrelationships, and changing situations. Research into any single question gives rise to new and interesting questions. The Division of Environmental Education offers opportunities in these areas.

The Outdoor Education program offers students mostly on the sixth level a resident program for one week on environmental studies. Teaching Science in the Elementary School describes a sound science program for all fifth and sixth grade students that strongly increases their chances for getting the most out of their science related activities at camp. A manual, The Outdoor Education Handbook is a guide to help principals and teachers become informed about the program and organize their own outdoor education experience.

Health Education

A curriculum bulletin, Health Education: A Curricular Approach to Optimal Health, Vol. 1., Maryland State Department of Education provides a broad, scientifically sound spectrum of concepts, behaviors, and knowledge which students K-12 can use to make responsible decisions about health behavior. Hopefully, these decisions will be translated into patterns of effective living.

Animal Studies (MACOS)

Salmon, herring, gulls, and baboons are examples of the animals included in part of the program, Man, A Course of Study by Curriculum Development Associates, Inc. This study of animal characteristics portrayed in booklets, films, filmstrips, records, and pictures depicts the life cycles and habits of various animals in their natural environments.

Resource Bulletins and Teacher Reference Materials

1. MCPS Program of Studies (1972) states the rationale of the MCPS science program; listed are content areas, program instructional objectives, and substantive topics for each level. Alternative programs are listed as suggestions for accomplishing a science program appropriate to the total school program and individual classroom needs. The Program of Studies should be useful in conjunction with this document, particularly in relating classroom activities to the MCPS goals for education.

2. Elementary Science Book List of Approved Library Titles - helpful in identifying approved library books.

3. Approved Textbook and Teaching Materials for Elementary Schools - a current list of approved textbooks, teacher guides, and professional books.

4. Traveling Library of the Science Teacher Specialists - a list of books, teacher guides, and science activities guides (listed in Appendix A) compiled to facilitate acquisition through the school IMC or library. These materials are especially useful as they include the printed substance of the science programs cited in the Program of Studies.

5. Behavioral Objectives in Concept Seeking by John R. Pancella. The behavioral objectives written for each activity in the K-6 series of Concepts of Science state outcomes for each activity as observable behaviors. Single copies have been made available to each school.

6. Structure of Curriculum and Instruction: Concepts in Science 1972 - teachers may use this document in developing the behavioral objectives on major con-

cepts to be taught in each content area. This curriculum support material contains charts for each band and level 1-6; the charts outline the relationship between concepts, operations for concept-seeking, and methods of process and behavior. This booklet is available through the subject supervisor's office.

7. WETA, Channel 26 - Elementary School Television Service Teacher's Guide - a television guide to assist teachers using weekly science programs on Channel 26, WETA. The guide has preteaching as well as postteaching materials related to lessons covered on television. These programs are adapted to various grade levels. The two-part guide is available to all primary and upper level teachers.

8. School Grounds as a Site for Inquiry, Bulletin #234 - a guide through pictures and illustrations for using the school grounds as an extension of the science program to further investigative techniques in developing inquiry and discovery methods of teaching.

ORGANIZING FOR INSTRUCTION

Planning a Science Program

Each teacher in planning a science program for the year should read the science section in the Program of Studies. In the following chapter of this document, alternatives are listed which are recommended for teaching or enriching the science content areas. The teacher should select, in accordance with materials for science available in the school, activities that support the substantive topics suggested in the Program of Studies. The teacher may choose to teach specific units of science for certain blocks of time. Other science concepts may be taught interrelated with social studies or reading.

The teacher may choose to teach specific science units, i.e., static electricity, for a designated number of days. Some science units may lead to interrelating with other subject disciplines, i.e., conservation. Some units of study are more appropriate for certain periods of the calendar. Static electricity, planting of seeds, study of the school grounds are topics that might fit certain seasons of the year.

It is especially important that plans for the year include times before and after selected field trips or other science related activities (outdoor education) for classroom activities. Preparing lessons and the follow-up classroom activities is often essential to the success of these special learning experiences. When scheduling blocks of time for units of study the chart on the next page may be helpful.

Science Program Plan for the School Year

		Fall			Winter				Spring		
		Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
Plan A 4 blocks 9 weeks each			9 weeks		9 weeks		9 weeks			9 weeks	
Plan B 6 blocks 6 weeks each		6 weeks		6 weeks		6 weeks	6 weeks		6 weeks		6 weeks
Plan C 8 blocks semester 1 4-5 5-4 weeks semester 2 4-5 5-4 weeks		4 wks	5 wks	5 wks		4 wks	4 wks	5 wks	5 wks		4 wks
Plan D	WEEK	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
Break-	1										
down	2								**		
of	3				*						***
weeks	4				*						***
in month	5				*						***

*Winter Vacation
**Spring Vacation (week changes each year)
***End of School

1. Plan A is a typical plan for kindergarten since only four content areas are in the program.

2. Plan B provides six weeks of study for each content area.

3. Plan C provides for a semester plan of work dividing each semester into segments of four or five weeks. It provides for a shorter time allotment allowing for more flexibility in planning the activities for a substantive topic.

4. Plan D provides for planning units of work on a weekly basis. It presents the total time available by weeks for the school year. It is recommended that you make use of "D" plan, weekly breakdown, in planning for "A, B, or C."

Teachers are encouraged to use this or some similar plan to map out the outline of a program involving each of the several content areas shown elsewhere in this paper.

7/8

2

An Overview of the Science Program: K-6

KEY
HEIGHT
0 1 2 3 4 5 6

II. AN OVERVIEW OF THE SCIENCE PROGRAM: K-6

An effective science program for children is a result of systematic planning and organizing. While details will vary from one teacher to another, organizing for effective instruction will involve the best use of time, procedures, materials, and activities to meet the program objectives that have been defined. The following section is intended to give guidance to the teacher in showing him the ways and means for instruction in science and in giving him a connection between program instructional objectives, content areas, substantive topics, and materials of instruction for the science program. A statement about children and science for each grade provides a frame of reference for the proper mix of children, materials, and activities. Also indicated in this section are possible alternatives for planning each science content area and its related activities. The science program deals with both process and content; it stresses knowledge of science, skills in processes of science, the investigative nature of science, and develops attitudes and appreciations of scientists and science.

SCIENCE PROGRAM INSTRUCTIONAL OBJECTIVES: K-6

The instructional objectives in science are an attempt to identify student behaviors that will be a direct product of the interaction of teachers and students as they work with substantive topics, content areas, and selected science materials. The instructional objectives are general statements that provide overall program direction for teachers as they prepare learning activities. The learning activities present inherent behavioral objectives and assessment tasks appropriate to the needs, abilities, and maturity levels of a wide range of students. These instructional objectives define a framework from which school staffs and individual teachers will derive more specific direction for carrying out the MCPS policy on evaluating and reporting student progress. From Grades K-2 to 3-4 and 5-6 the science activities for children are expected to involve different levels of thought processes involving developmental stages from the concrete to formal thought or abstract reasoning.

CHILDREN AND SCIENCE: GRADES K-2

Children discover new meanings through their sensory experiences; seeing, hearing, tasting, smelling, listening, and talking help them interpret events in their environment. Practice in manipulating, observing, selecting, and ordering encourages children to seek solutions to individual questions and problems. As children grow and mature, they are encouraged to observe carefully, to test their ideas by experimentation, and to check their explanations. To increase powers of observation and skills involved in experimentation, children are confronted with problem-solving activities that help them interpret physical and biological phenomena. Children are involved in their immediate outdoor environment and make increased use of the school grounds and nearby communities.

After the science teacher has identified his content area and the substantive topic he can then select from the instructional objectives those that he feels are being accomplished by pupils in his class. During the year, the teacher will assure that every student has experiences with each instructional objective below through carefully selected activities:

1. Observe objects, living things, and happenings in their environment

2. Wonder about their environment and ask questions

3. Investigate by manipulating materials, talking, listening, thinking, and reading
4. Make guesses about the happenings in their environment
5. Identify properties and attributes of materials to group or categorize
6. Discover similarities and differences among materials, substances, and their properties
7. Learn to accept evidence about events in making conclusions
8. Practice skills and identify terms effective in finding relationships in a variety of materials, objects, and organisms
9. Search for more information about material objects and their interaction
10. Discuss and record their science observations and experiences
11. Build their science vocabulary through manipulative activities involving verbal and nonverbal communication
12. Develop an awareness of the variety among things and some relationships between things in their environment
13. Identify time/space and material objects in an ordered sequence and recognize interrelationship of organisms to their environment
14. Relate to their environment through group activities and interrelationships that recognize them as individuals with both responsibilities and privileges in the group
15. Observe the presence of a variety of living and nonliving parts of their own ecosystem
16. Develop basic skills in observation, manipulation, organizing, and grouping
17. Develop awareness of things in their environment that can be explained through use of their senses and on the basis of the orderliness of nature
18. Indicate an awareness of scientists and their achievements through dramatization of stories and role-playing

A Design for Elementary Science: K-2

This design for elementary science shows correlation between the content areas, the substantive topic, and grade level. A major aspect of planning for science at each level involves selection and ordering of content or science topics. The following chart selects from the total K-6 program those segments that are to be taught in Grades K-2. Planning for the classroom science period on a regular basis is essential to accomplishing a science program. The amount of time for science is established as a specific number of minutes each week. Suggestions for distributing that time over each week of school are made here to give substance to the need for at least that amount of time in a planned schedule.

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are inter-dependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
K	Force and Motion	Properties of Matter	Environmental Differences	Needs and Processes of Living Things		
1	Forms of Energy	Forms of Matter	Effect of Environment on Living Things	Reproduction	Forms of Life	Earth and Daily Changes
2	Energy Changes	Matter and Motion	Environmental Conditions for Life	Life Cycles	Extinct Life	Movements of Earth and Moon

Planning for Science: K-2

In planning for each topic and its related activities, allow six to nine weeks with class periods totaling 125 minutes per week.

The science periods can be scheduled depending on the level of the students and the type of activity planned. A breakdown of the week into three sessions may appear, in minutes, as:

Monday	Tuesday	Wednesday	Thursday	Friday	Total
50		50		25	125
	45	45	35		125
	40	40		45	125
55		35		35	125

or science periods may be planned daily:

Monday	Tuesday	Wednesday	Thursday	Friday	Total
25	25	25	25	25	125

Instructional Materials: K-2

There is a wide and varied range of instructional materials that K-2 teachers can use to help youngsters acquire skills and knowledge in science. To form a total elementary science program a systematic categorization of the resources has been made for each band or level.

The following chart for the K-2 band is a planning tool with specified sources of materials and activities to assist teachers and principals in selecting locally, nationally, and commercially developed curricula to support the instructional objectives, content areas, and substantive topics as outlined in the MCPS Program of

Studies. Teachers and principals are placed in a decision-making role as they select specific materials with related pupil activities that lead to a balanced science program in their schools.

Abbreviations for sources of materials and activities as shown on the following chart are consistent with the abbreviations used throughout the Program of Studies.

MCPS - Montgomery County Public Schools
CIS - Concepts in Science
ESS - Elementary Science Study
EIS - Experiences in Science
SCIS - Science Curriculum Improvement Study

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are interdependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
K	FORCE AND MOTION	PROPERTIES OF MATTER	ENVIRONMENTAL DIFFERENCES	NEEDS AND PROCESSES OF LIVING THINGS		
	MCPS...Ramps SCIS...Material Objects CIS...Unit 2 Investigating Force and Motion	MCPS...Grouping SCIS...Material Objects CIS...Unit 1 Investigating Matter EIS...Groups ESS...Attribute Games and Problems	SCIS... Organisms CIS...Unit 3 Investigating Animals Unit 4 Investigating Plants	MCPS...Pets and Other Animals SCIS... Organisms CIS...Unit 5 Children as Living Things EIS...Life Histories		

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are interdependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
Grade Level	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
1	FORMS OF ENERGY	FORMS OF MATTER	EFFECT OF ENVIRONMENT ON LIVING THINGS	REPRODUCTION	FORMS OF LIFE	EARTH AND DAILY CHANGES
	MCPS...Sound Magnets SCIS...Interaction and Systems CIS...Unit 1 Making Things Move Unit 2 Moving Faster Unit 3 Up and Down EIS...Hot and Cold EIS...Light and Shadows ESS...Spinning Tables	SCIS...Material Objects CIS...Unit 4 Hot and Cold Unit 5 Cloudy or Sunny ESS...Attribute Games and Problems ESS...Sand ESS...Drops, Streams and Containers ESS...Pattern Blocks	SCIS...Organisms CIS...Unit 7 Plants and More Plants Unit 8 Animals and More Animals Unit 9 Living Things Grow Unit 10 We Grow Unit 11 Long, Long Ago EIS...Plants in Spring	SCIS...Organisms CIS...Units 7, 8, 10 ESS...Growing Seeds EIS...Plants in Spring EIS...Young Animals	MCPS...Seeds SCIS...Organisms CIS...Units 7, 8, 9, 10, 11	CIS...Unit 6 Light and Dark ESS...Light and Shadows EIS...Earth and Sun EIS...Weather

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are interdependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
2	ENERGY CHANGES	MATTER AND MOTION	ENVIRONMENTAL CONDITIONS FOR LIFE	LIFE CYCLES	EXTINCT LIFE	MOVEMENTS OF EARTH AND MOON
	SCIS...Interaction and Systems CIS...Unit 2 Molecules at Work Unit 5 Darkness and Light Unit 3 Fuels at Work Unit 4 Silence and Sound Also Unit 6 EIS...Balance EIS...Magnets EIS... Batteries ESS...Mirror Cards	MCPS...Grouping SCIS...Interaction and Systems CIS...Unit 1 The Very Small Also Units 2 and 3 EIS...Air ESS...Primary Balancing EIS...Balances	MCPS...Plants SCIS...Life Cycles CIS...Unit 6 Plants Live and Grow Also Units 7 and 8 EIS...Living Things	SCIS...Life Cycles CIS...Unit 7 Animals Live and Grow Also Unit 6 ESS...Brine Shrimp ESS...Life of Beans and Peas	SCIS...Life Cycles CIS...Unit 8 We Grow and Change Unit 10 Millions of Years Ago ESS...Brine Shrimp ESS... Butterflies	SCIS...Interaction and Systems CIS...Unit 9 The Very Large ESS...Where is the Moon

CHILDREN AND SCIENCE: GRADES 3-4

In Grades 3 and 4, children observe and experiment and continue to interpret everyday happenings. They are encouraged to seek solutions to questions and problems dealing with increasingly complex phenomena. They make measurements, record data, and share information within groups. Children make greater use of simple models, instruments, and other science materials. They observe the interaction of various plants and animals, and they consider the interdependence of individuals and population. Children consider the physical conditions that determine an organism's environment. They deal more with science as inquiry and facility in interpretation of events in the environment. The children are asked to describe the changes they observe with increased precision. They deal with special relationships of moving and stationary objects and get a greater understanding of large concepts such as diversity and motion of molecules.

After the science teacher has identified his content area and the substantive topic, he can then select from the instructional objectives those that he feels are being accomplished by pupils in his class. During the year, the teacher will assure that every student has experiences with each instructional objective below through carefully selected activities:

1. Express their own ideas about their observations
2. Recognize a problem
3. Investigate by manipulating materials and recording their results on tables, diagrams, graphs, and charts
4. Select the hypothesis which offers the best explanation to a problem
5. Begin to select data which are pertinent to the problem
6. Relate previous experience to new situations
7. Make choices and draw conclusions from evidence obtained
8. Organize their scientific findings using such devices as lists, pictures, diagrams, models, reports, exhibits, collections, and stories
9. Improve their skills in reorganizing ideas in the light of new information
10. Communicate descriptions of activities and their results
11. Use with understanding science words appropriate to their level of maturity
12. Evaluate their efforts and continue to strive for improvement by setting new standards
13. Recognize variety, time, space, adaptation, balance, and interrelationships
14. Develop a positive self-concept and see themselves as worthy and acceptable individuals who have worthwhile contributions to make to the group
15. Increase their awareness of the interrelationship of plants, animals, and the physical environment
16. Demonstrate that science is an orderly process involving cause and effect relationships perceivable through investigation by human beings

17. See that while change is continuous there are cycles and patterns that give a degree of stability that insures predictability of events important in the lives of men

18. Identify some of the ideas and discoveries of men and women in science who have made significant contributions to our body of knowledge

A Design for Elementary Science: 3-4

This design for elementary science shows correlations between the content areas, the substantive topic, and grade level. A major aspect of planning for science at each level involves selection and ordering of content or science topics. The following chart selects from the total K-6 program those segments that are to be taught in Grades 3-4. Planning for the classroom science period on a regular basis is essential to accomplishing a science program. The amount of time for science is established as a specific number of minutes each week. Suggestions for distributing that time over each week of school are made here to give substance to the need for at least that amount of time in a planned schedule.

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are interdependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
3	Radiant Energy	Structure of Matter	Environments and Related Living Forms	Classification of Living Things	Environmental Changes	Solar System and Change
4	Energy and Motion	Chemical Changes	Exchange Between Living Things and Environment	Environment and Reproduction	Living Things and Environmental Changes	Celestial Bodies and Motion

Planning for Science: 3-4

In planning for each topic and its related activities, allow six weeks with class periods totaling 125-225 minutes per week.

The science periods can be scheduled depending on the level of the students and the type of activity planned. A breakdown of the week into three sessions may appear in minutes as:

Monday	Tuesday	Wednesday	Thursday	Friday	Total
80		80		65	225
	65		65	95	225
	90		90	45	225

The time might be divided into daily sessions of:

Monday	Tuesday	Wednesday	Thursday	Friday	Total
45	45	45	45	45	225
50	50	50	50	25	225

Instructional Materials: 3-4

There is a wide and varied range of instructional materials that teachers of grades 3 and 4 can use to help youngsters acquire skills and knowledge in science. To form a total elementary science program a systematic categorization of the resources has been made for each band or level.

The following chart for the 3-4 band is a planning tool with specified sources of materials and activities to assist teachers and principals in selecting locally, nationally, and commercially developed curricula to support the instructional objectives, content areas, and substantive topics as outlined in the MCPS Program of Studies. Teachers and principals are placed in a decision-making role as they select specific materials with related pupil activities that lead to a balanced science program in their schools.

Abbreviations for sources of materials and activities as shown on the following chart are consistent with the abbreviations used throughout the Program of Studies.

MCPS - Montgomery County Public Schools
CIS - Concepts in Science
ESS - Elementary Science Study
EIS - Experiences in Science
SCIS - Science Curriculum Improvement Study

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are interdependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
3	RADIANT ENERGY	STRUCTURE OF MATTER	ENVIRONMENTS AND RELATED LIVING FORMS	CLASSIFICATION OF LIVING THINGS	ENVIRONMENTAL CHANGES	SOLAR SYSTEM AND CHANGE
	SCIS... Subsystems and Variables CIS...Unit 1 Energy from the Sun Unit 2 Energy at Work EIS...Heat-Motion-Sound	SCIS... Subsystems and Variables CIS...Unit 4 The Forms of Things EIS...Changes ESS...Mystery Powders ESS...Match and Measure ESS...Printing ESS...Mobiles ESS...Changes	MCPS...Habitats SCIS... Populations CIS...Unit 5 Treasures in the Earth Unit 6 Kinds of Living Things Animals Also Units 7 and 8 EIS...Plant and Animal Responses	SCIS... Populations CIS...Unit 7 Kinds of Living Things-Plants Also Units 5, 6, 8 ESS...Brine Shrimp Life of Beans and Peas EIS...Life Histories	SCIS... Populations CIS...Unit 8 In Water and on Land Also Units 5, 6, 7	MCPS...Earth in Space CIS...Unit 3 Beyond the Earth Also Units 1, and 2 EIS...Earth, Sun and Season

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are inter-dependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
4	ENERGY AND MOTION	CHEMICAL CHANGES	EXCHANGE BETWEEN LIVING THINGS AND ENVIRONMENT	ENVIRONMENT AND REPRODUCTION	LIVING THINGS AND ENVIRONMENTAL CHANGES	CELESTIAL BODIES AND MOTION
	SCIS...Relative Position and Motion		SCIS... Environments			SCIS... Relative Position and Motion
	CIS...Unit 1 The Bounce of Sound Unit 2 The Bounce of Light Unit 3 The Travels of a Drop of Water	CIS...Unit 4 Travels of Some Materials Unit 7 Travels of a Handful of Soil	CIS...Unit 5 The Fall of a Tree Unit 6 Journeys of a Salmon and a Duck Also Units 3 and 4	CIS...Units 5 and 6 SCIS... Environments	CIS...Unit 7 The Travels of a Handful of Soil Also Units 5 and 6 SCIS... Environments	CIS...Unit 8 The Voyages of Halley's Comet
	ESS...Ice Cubes MCPS...Melting Ice	ESS... Mystery Powders	MCPS...School Grounds as a Site for Inquiry		ESS...Animal Activity ESS...Eggs and Tadpoles	
	EIS...Solids, Liquids, Gases ESS...Musical Instrument Recipe Book ESS...Heating and Cooling ESS...Whistles and Strings	EIS...Chemical Changes ESS...Clay Boats ESS...Sink or Float	EIS...Ecology EIS...Adaptations		ESS...Animal Activities in the Classroom	EIS...Atmosphere and Weather Geologic Processes

CHILDREN AND SCIENCE: GRADES 5-6

In the upper elementary grades, children have matured and developed a set of skills in observation, measurement, and recording of data. A continued emphasis is placed on confrontation with problem-solving activities. Investigative procedures are practiced and increased skills are gained in making interpretations and analyzing data. The exchange of matter and energy between plants and animals and their physical environment is investigated, and children are asked to deal with the concept of scientific models. Children make hypotheses to assist them in making interpretations of physical phenomena of the earth and the universe. They learn to identify variables, relate matter and energy to electrical phenomena, interpret factors in the environment, and see the electrical nature of all matter. Children practice putting things in order in such a way that they can provide more meaningful interpretations of the world in which they live.

After the science teacher has identified his content area and the substantive topic, he can then select from the instructional objectives those that he feels are being accomplished by pupils in his class. During the year, the teacher will assure that every student has experiences with each instructional objective below through carefully selected activities:

1. Observe for the purpose of making inferences
2. Recognize the mechanics involved in problem solving
3. Investigate by recognizing data collecting and using data in solving problems
4. Formulate their observations into statement of hypotheses
5. Differentiate between reliable and less reliable resources for information, and question sources
6. Identify sets of conditions and recognize that these lead to specific inferences
7. Withhold judgments until they consider all available evidence
8. Acquire scientific information and concepts and organize them into meaningful generalizations
9. Recognize as logical the sequence in events such as cause and effect
10. Express results of data collected in graphs, charts, symbolic forms, and mathematical terms
11. Increase their science vocabulary and relate this vocabulary to new situations
12. Reorganize their ideas in the light of new information
13. Acquire scientific information and begin to make meaningful inferences useful in making generalizations

14. Recognize and acknowledge a job well done and be aware of feelings of personal satisfaction in their accomplishments and contributions

15. Recognize that all human activities depend on the state of their physical being, and their lives are determined by conditions in their physical and biological environments

16. Recognize that men of science have made special contributions to the world at large through activities in research and study

17. Demonstrate that science and technology are products of human endeavor and that in turn man is a product of his heredity and the societal environment

18. Describe and evaluate the role of the scientific enterprise during the history of man

A Design for Elementary Science: 5-6

This design for elementary science shows correlation between the content areas, the substantive topic, and grade level. A major aspect of planning for science at each level involves selection and ordering of content or science topics. The following chart selects from the total K-6 program those segments that are to be taught in Grades 5-6. Planning for the classroom science period on a regular basis is essential to accomplishing a science program. The amount of time for science is established as a specific number of minutes each week. Suggestions for distributing that time over each week of school are made here to give substance to the need for at least that amount of time in a planned schedule.

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are interdependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
5	Energy, Force, and Motion	Conservation of Matter	Green Plants and Radiant Energy	Cells	Living Things and Time	Celestial Bodies and Change
6	Energy Systems	Matter and Energy in Nuclear Reactions	Adaptations of Living Things	Genetics and Characteristics	Genetics and Change	Radiant Energy of Stars

Planning for Science: 5-6

In planning for each topic and its related activities, allow six weeks with class periods totaling 225 minutes per week.

The science periods can be scheduled depending on the level of the students and the type of activity planned. A breakdown of the week into sessions may appear in minutes as:

Monday	Tuesday	Wednesday	Thursday	Friday	Total
80		80		65	225
	65		65	95	225
	90		90	45	225

The time might be divided into daily sessions of:

Monday	Tuesday	Wednesday	Thursday	Friday	Total
45	45	45	45	45	225
50	50	50	50	25	225

Instructional Materials: 5-6

There is a wide and varied range of instructional materials that teachers of grades 5 and 6 can use to help youngsters acquire skills and knowledge in science. To form a total elementary science program a systematic categorization of the resources has been made for each band or level.

The following chart for the 5-6 band is a planning tool with specified sources of materials and activities to assist teachers and principals in selecting locally, nationally, and commercially developed curricula to support the instructional objectives, content areas, and substantive topics as outlined in the MCPS Program of Studies. Teachers and principals are placed in a decision-making role as they select specific materials with related pupil activities that lead to a balanced science program in their schools.

Abbreviations for sources of materials and activities as shown on the following chart are consistent with the abbreviations used throughout the Program of Studies.

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CIS - Concepts in Science
ESS - Elementary Science Study
EIS - Experiences in Science
SCIS - Science Curriculum Improvement Study

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are inter-dependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
5	ENERGY, FORCE, AND MOTION	CONSERVATION OF MATTER	GREEN PLANTS AND RADIANT ENERGY	CELLS	LIVING THINGS AND TIME	CELESTIAL BODIES AND CHANGE
	SCIS...Energy Sources CIS...Unit 1 The Earth Inside and Out Also Unit 3 ESS...Stream Tables ESS...Optic Structures EIS... Unbalanced Forces	SCIS...Energy Sources CIS...Unit 2 Building Blocks Also Units 1 and 5 Unit 7 Building Blocks of Stars ESS...Colored Solutions ESS...Peas and Particles ESS...Balloons and Gases ESS...Tangrams	SCIS... Communities CIS...Unit 6 Green Cells as Building Blocks MCPS...School Grounds as a Site for Inquiry	MCPS...Cells MCPS...Pond Study CIS...Unit 4 Building Blocks of Living Things Unit 5 Building Blocks of Body Also Unit 6 ESS...Micro-gardening Bones Pond Water Small Things Budding Twigs EIS...Micro-scopic Life	SCIS... Communities CIS...Unit 8 Stories in the Earth Also Unit 4	SCIS...Energy Sources CIS...Unit 3 Earth in Orbit Also Units 1 and 7 ESS...Rocks and Charts EIS...Time EIS...Mapping EIS...Balancing Forces

CONTENT AREAS

	When energy changes from one form to another, the amount of energy remains unchanged.	When matter changes from one form to another, the amount of matter remains unchanged.	Living things are inter-dependent with one another and with their environment.	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
Grade Level	PHYSICAL INTERACTIONS		BIOLOGICAL INTERDEPENDENCIES			CHANGING UNIVERSE
	ENERGY	MATTER	LIVING THINGS			
	SUBSTANTIVE TOPICS					
6	ENERGY SYSTEMS	MATTER AND ENERGY IN NUCLEAR REACTIONS	ADAPTATIONS OF LIVING THINGS	GENETICS AND CHARACTERISTICS	GENETICS AND CHANGE	RADIANT ENERGY OF STARS
	MCPS...Liquids SCIS...Models: Electric and Magnetic Interaction ESS... Batteries and Bulbs Kitchen Physics Pendulums	SCIS...Models Electric and Magnetic Interaction ESS...Gases and Airs	SCIS...Ecosystems ESS...Behavior of Mealworms Crayfish EIS...Life Process of Plants MCPS...School Grounds as a Site for Inquiry	EIS...Continuity of Life		EIS...The Universe ESS...Daytime Astronomy
	EIS...Light Color CIS...Unit 4 Machines in Action Also Units 5, 6, 7 EIS...Electricity	CIS...Unit 5 Molecules in Action Unit 6 Electrons in Action Unit 7 Matter into Energy Also Units 1, 3, 9 ESS...Water Flow ESS...Senior Balancing MCPS...Liquids	CIS...Unit 1 Learned and Unlearned Behavior Unit 2 Ideas and Tools: For Longer Life Also Unit 3 ESS...Tracks ESS...Mosquitoes ESS...Mapping MCPS...Pond Study	CIS...Unit 3 Ideas and Tools for Longer Life Also Unit 8	CIS...Unit 8 Code of Heredity	CIS...Unit 9 Stars and Starlight

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3

Planning and Organizing for Teaching Science

III. PLANNING AND ORGANIZING FOR TEACHING SCIENCE

In the elementary science curriculum, emphasis is given to an activity-centered classroom. Children learn through their own experiences with materials and investigations selected and designed to take advantage of their natural curiosity. Confronted with such experiences, the child acquires concepts by recreating them for himself. The elementary school years are a period of transition. As children grow and mature they need guidance and encouragement in using many procedures of scientific inquiry. Self-discovery is essential to science education, and children use their curiosity and imagination as they take part in activities involving many sensory experiences. The science program in Grades K-6 places emphasis on biological science and physical science.

Every child must be insured the opportunity to develop a literacy in science. When asked what children should rightfully know as a result of their science experiences, the answer should encompass:

1. Knowledge of science (facts and generalizations)
2. Abilities and skills in processes of science
3. Understandings of the investigative nature of science
4. Appreciation of and attitudes about science and the consequences of science

Emphasis is not placed on any one set of materials as being the best science program for all elementary children in Montgomery County. Therefore, as outlined in the Program of Studies five basic and widely accepted sets of learning materials are suggested for the teacher's selection. The recommended materials do not automatically exclude the use of other science materials. The total staff of a school, as well as individual teachers, have responsibilities for selecting appropriate instructional materials and organizing for science to meet the strengths and needs of individual students. Each school should have available adequate science equipment, a wide variety of science oriented library books, and carefully selected science textbooks which appropriately support the school science program. Each teacher should in turn extend his skills in working with these various materials and in organizing different ways of using them. This kind of planning and organizing is basic to a productive and enriching science program for all students in Grades K-6.

LEARNING ABOUT INDIVIDUAL STRENGTHS AND NEEDS

Individual Differences in Learning Style

An individual's learning style is made up of many components. Three of these components deal with the ways in which he receives information and impressions; the way he responds to learning situations; and the way in which he typically organizes his thinking. Science activities, by their emphasis on "doing," provide opportunities for individualized learning style.

Sensory Orientation

The teacher needs to be aware of which senses pupils use in the act of learning. He should provide activities that promote the use of those senses; the lessons should vary in a way that causes the student to use his spectrum of senses as instruments of learning.

Responsive Mode

Children differ from one another in their response to:

1. The kind and size of group they are in for various instructional purposes
2. The kind of expectation or challenge that is set for them, or which they set for themselves
3. The way in which the teacher reacts to individual children
4. The instructional material or activity with which he is involved

Some youngsters learn most effectively on a one-to-one basis with the teacher. Others, by contrast, learn best in a fairly large group. Still others are more comfortable and learn best in a group of four, five, or six. Some youngsters learn best through independent activities. Others need the support of their peers as they pursue new learnings. Teachers soon learn which kinds of groupings are most appropriate, and most effective, for which youngsters. Over a period of time, when children are tried in various kinds of groups, the teacher comes to understand which grouping pattern fits each youngster best. The nature of science activities provides the teacher with excellent opportunities for a full range of possible groupings; she can use one-to-one, pairs, small groups, and total class as effective ways for children to be involved with science.

Science activities present challenging opportunities for children. Some children respond well to challenge. A challenge may be offered by the teacher, or it may be self-motivated or generated. However, there are some children who become frozen or stymied by too large a challenge. A learning task might be so overpowering to them that they don't know where to begin. Some children know where to begin, but they express no hope of ever being able to complete tasks; these children need to have learning tasks laid out in small, manageable pieces. By gradually presenting larger or broader challenges, the teacher learns the size and scope of challenge that is more productive for each child.

Individual children react differently to teachers' ways of teaching. Some youngsters need very definite directions from the teacher. Some need less direction and greater freedom for defining their own involvement in a learning task. There are children who need a great deal of support from the teacher as they pursue an activity. There are others who want to be left alone. As the teacher begins to understand the most effective relationship between himself and the individual child, he learns to regulate his own behavior as he works with each individual, whether on a one-to-one basis or in a group setting.

Depending on their values, interests, and motivations, youngsters respond in various ways to different instructional materials and activities. The broad spectrum of topics in science and the inherent variety in ways for children to be involved in learning activities increases the chances for individualization.

Thinking Pattern

Children differ in the ways in which they organize what they have learned. Some youngsters learn best by first gathering many facts and organizing them into a meaningful whole. Their thinking pattern is a steady, step-by-step, inductive procedure. Other youngsters learn best by quickly coming to a main idea, a generalization, and then testing it out by looking at specific bits of information to see whether or not their generalization holds. They take great chunks of information and make quick, intuitive leaps from them in their thinking. Their thinking pattern is predominantly deductive.

Selected science lessons can be used to illustrate ways to solve problems using different styles or approaches. One pattern is not necessarily better than the other; they are just different. But if we are to plan and organize appropriately, we need to know which thinking patterns are most effective for which youngsters. Most importantly, the children should have opportunities to learn how to rely on their thinking as a tool for finding out; they must experience inquiry, discovery type learning situations. The more we can learn about how to match teaching strategies, materials, and organizational patterns with children's learning styles, the more likelihood there is that efficient and meaningful learning will take place in the classroom.

SCHOOL-WIDE PLANNING FOR CURRICULUM AND SCIENCE MATERIALS, TEXTBOOKS, AND EQUIPMENT

Science materials and equipment are essential to any good science program. The materials and equipment will vary from school to school but should have some similar components. The Concepts in Science Classroom Laboratories kits are available in nearly every elementary school. Other materials may vary due to differing points of view and program selections for a particular school's program. It will be essential that a school's faculty make some decisions about their science program in light of their existing materials. Plans for additional materials should be made with total school program in mind. It would seem advisable to seek the help of the science teacher specialist to bring pertinent information to this planning session.

The Montgomery County Public Schools have approved a variety of materials of instruction for elementary science. These materials and kits for instruction can be found in many MCPS elementary schools.

CIS (Concepts in Science)

There is perhaps no aspect of science learning that is more important than the child's personal involvement in the act of investigation, which includes working with materials and processes, and using the methods of exploring and discovering characteristics of things scientists do. The child has direct confrontation within a framework of inquiry; his work can be self-initiated, and he can often set his own objectives as he explores. Questions are raised and then pursued by trying to find out.

Seven classroom laboratory sets (called Classroom Laboratories) are the inner spine of the Concepts in Science program. These sets which are planned for convenient classroom management provide a practical way of temporarily converting a regular classroom into a laboratory oriented class.

To provide opportunities for an entire class to experience concept-seeking, each set contains materials for use by up to six groups of children. The quantities are sufficient for performing investigations that parallel the Concepts in Science textbooks. In addition, materials are provided for other investigations and for open-ended searches. Recent changes in the Classroom Laboratories have increased the potential for direct hands-on, manipulative experiences for increased numbers of children in the classroom.

The Classroom Laboratories in the Montgomery County Public Schools at the present time can be more effectively used, with added opportunities for hands-on science, by the purchase of a Supplemental Tray (new in 1972) for use with each level K-6. The trays bring additional sets of materials to the science program thereby giving children more chances for doing science rather than simply seeing or hearing about science.

SCIS (Science Curriculum Improvement Study)

The Science Curriculum Improvement Study consists of two series of related and sequential units. One unit in life science and one in physical science are paired for each six levels. Taking advantage of the natural curiosity of children, SCIS presents a wide variety of phenomenon for classroom exploration and investigation. At each of the six levels numerous inquiry-oriented activities help children accumulate experiences and ideas which advance their thinking from the concrete to the abstract and enable them to relate scientific concepts to the everyday world.

Teaching strategies based on current theories about how children learn play a major role in the SCIS program. Three stages in a child's learning cycle are provided for. In exploration, the child explores carefully chosen materials with minimal guidance from the teacher. In invention, the teacher supplies a definition and a term for a concept new to the child. In discovery, the child finds a new application for a concept. Discovery activities reinforce the original concept and enlarge and refine its meaning. Since there are many "right" answers, the child develops a feeling of success which carries over into other areas. The diversity of materials and investigations enriches his vocabulary and leads to growth of language skills.

ESS (Elementary Science Study)

Elementary Science Study has as its principal aim the production of materials of high scientific quality that appeal to children. The units are the unique products of joint efforts by scientists and teachers from many disciplines and levels of education. ESS is a series of activity-centered units that make it possible for the classroom to be laboratory oriented. The materials are intended to take advantage of the child's natural curiosity about the world around him. He develops methods for devising and carrying through his own investigations and records his conclusions systematically. Students work with a wide variety of materials which help them to see new dimensions in their environment. These flexible units free pupils and teachers from traditional book-centered approaches and let them learn through experience-type activities.

The units are plugged into the overall scheme for science programs and provide acceptable alternatives or additions for many of the prescribed substantive topics.

EIS (Experiences in Science)

Experiences in Science is an experience-centered program that builds upon the child's natural curiosity. Experiences in Science allows each child to participate in each experiment; this active participation gives him an apparently far deeper understanding of science as a "doing" process. Unit topics have a fundamental importance to the whole of science instruction and are included in the MCPS program as a set of support activities that help accomplish substantive topics.

With EIS materials pupils learn to base their responses on careful observation. The science topics chosen are those which particularly lend themselves to teaching basic process skills such as comparison, measurement, classification, and consequent generalization. Experiences in Science is a flexible approach to the teaching of elementary science, and as such it offers teachers and principals a decision as to where and how much of it will effectively enhance the school program.

MCPS (Montgomery County Public Schools Science Units)

Montgomery County Public Schools Elementary Science Guides provide a teacher with a description of and procedures for carrying out a science activity or activities at each grade level. These units cover physical science and life science substantive topics. In the main they encourage first-hand investigation, observing, hypothesizing, and experimentation about events in the elementary child's life. The units develop skills of measurement, counting, grouping, notation, and graphing. The child's manipulation of materials of investigation becomes a strong factor in these science studies. Incorporated in the Program of Studies as support for, or as alternative science activities in carrying out the substantive topics, the MCPS science units continue to be an element in the total science program. The units are available upon request from the Textbook Depository.

The teachers will find in the current Approved Textbooks and Text Materials for Elementary Schools all approved textbooks for MCPS. To know which texts support any one of the above programs the teacher will want to contact the area teacher specialist and make arrangements to see the current approved textbooks. A new teacher may find a science textbook on which he can build his science program, but as the teacher becomes more comfortable with science he will only use texts as a support system and not as a program.

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Elementary Science Frameworks Models for Using Science Activities

IV. ELEMENTARY SCIENCE FRAMEWORKS: MODELS FOR USING SCIENCE ACTIVITIES

The "frameworks for elementary science" are designed to promote a viable science program for children in each classroom in every building. They provide direction for the teacher in planning her science activities; they help in selection of materials for use with children in the classroom; they describe kinds of activities to do with children to assure achievement of a wide range of performance objectives; and they suggest level or age group parameters for selected science content. Along with promoting a science program for children, a primary purpose of the frameworks is to lighten some of the preparation and selection burdens in the already busy daily routine of each classroom teacher.

The "frameworks for elementary science" (pp. 33-112) are aimed toward organizing science by first identifying for each teacher one of a set of three bands K-2, 3-4, or 5-6. The organization is easily adapted for levels K-6. Science content areas in all frameworks are the main divisions of the whole of science. It is appropriate to speak of the pie of science being cut into six pieces with the six pieces under the umbrella of physical science and biological science. The content areas deal with concepts that should be experienced at each level regardless of school organization. The designated content areas or major concepts give direction so that each child experiences his share of substantive science activities spread across the spectrum of science.

Teachers following the suggested content and process guidelines will be working toward attainment of those program instructional objectives that are stated for each level in the Program of Studies. Teachers are expected to select from the list of program instructional objectives those particular objectives that relate to the lesson or science activity they have chosen. The separate sections or parts of each framework for elementary science demonstrate for each teacher a repeatable method or model that leads to grade-level selection of content area, substantive topic, activity, behavioral performance objectives, alternate activity and sources of additional activities. The models, as a group, have been designed to take the teacher through a sample science activity in each and every one of the content areas (main divisions of the whole of science) that he is expected to work with during the course of the year.

During the course of each year the children are expected to experience a variety of problem-solving, inquiry-oriented, science activities. These experiences should enable each student within his individual capabilities to be able to do those things described in the listing of instructional objectives (pp. 9, 15, 20). Accomplishment of this task concerning instructional objectives is expected of teachers at each grade level or age group. An example of application for this task is given in each model in the framework for elementary science. Selected objectives have been taken from the list of instructional objectives and placed with specific science activities; this illustrates how the program objectives to be accomplished by the teacher and her children by the end of the year may be associated with each substantive topic.

The frameworks for elementary science are oriented toward the concept of a total school science program K-6. In selection of content, behavioral performance objectives, and instructional objectives, the frameworks describe a way to accomplish an elementary science program as projected in the Program of Studies. As a set of guidelines it will prove useful to teachers, principals, science teacher specialists, general supervisors, area administrators, parents, and others who find it necessary to interpret, describe, or otherwise articulate the elementary science program K-6. It is intended to be most useful in providing children with a set of related, meaningful experiences that result in increased literacy in science.

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

. observe objects, living things, and happenings in their environment
. wonder about their environment and ask questions
. investigate by manipulating materials, talking, listening, thinking, and reading
. identify properties and attributes of materials to group or categorize data

Content Area:

When energy changes from one form to another, the total amount of energy remains unchanged.

Substantive Topic (Suggested Level):

Force and Motion (Level K)

Activity (Title and Description):

Horizontal Motion and Change in Motion (CIS, Yellow)

Children will learn about forces. Things will not move until a force is applied. A greater force must be applied to a heavy object if you wish to move it. Children will learn that once an object is moving a force is required to stop it.

Behavioral Performance Objectives:

The child will demonstrate that a push or pull is needed to make things move by moving various objects.

The child will name pushes and pulls as forces.

The child will describe heavier objects as those that need more force to move them.

The child will describe that a force is needed to stop an object that is moving by observing that rolling objects that have been moved will come to a stop.

The child will demonstrate that a force is needed to change the direction of a rolling object.

Alternate Activity (Title and Description):

Investigating Matter-Sound (CIS, Yellow)

The teacher will discuss with the children the different sounds they have heard. The teacher will hold two cups before the class. When the teacher shakes one cup, the class will hear a sound made by an object inside the cup. When the teacher shakes the other cup, no sound is made since there is no object inside the cup. The children can use other objects that will make sounds in the cups. The children can separate objects which make sounds from those objects that do not make sounds. As children become familiar with objects that make sounds, they will be able to identify the objects by the sounds made. They may also identify objects which make similar sounds.

Behavioral Performance Objectives:

The child will identify objects which make sounds.

The child will describe objects by the sound they make.

The child will distinguish objects by various sounds made.

Sources of Additional Activities for Substantive Topic: Force and Motion

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following source. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . Ramps

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- observe objects, living things, and happenings in their environment
- wonder about their environment and ask questions
- investigate by manipulating materials, talking, listening, thinking, and reading
- identify properties and attributes of materials to group or categorize data

Content Area:

When matter changes from one form to another, the total amount of matter remains unchanged.

Substantive Topic (Suggested Level):

Properties of Matter (Level K)

Activity (Title and Description):

Shapes, Textures, and Colors (CIS, Yellow)

This activity will give the children an opportunity to group objects according to their properties. Objects will be grouped according to shape, color, and textures. The children will learn that objects can be grouped in sets and the sets contain subsets. Children will be involved in many activities which require them to investigate their environment.

Behavioral Performance Objectives:

The child will identify a variety of objects by size, shape, color, texture, and material.

The child will name a variety of objects by size, shape, color, texture, and material.

The child will order a variety of objects according to their likenesses and differences.

Alternate Activity (Title and Description):

Attribute Games and Problems (ESS)

Using a set of wooden squares, triangles, circles, and diamonds, in large and small sizes, children will group the shapes according to red, yellow, blue, and green. Groups will be organized by the children using the squares, triangles, diamonds, and circles as the properties for grouping. The children will construct groups with common characteristics (color-shape-size).

Behavioral Performance Objectives:

The child will identify a variety of objects by size, shape, and color.

The child will name a variety of objects by size, shape, and color.

The child will order a variety of objects according to their likenesses and differences.

Sources of Additional Activities for Substantive Topic: Properties of Matter

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . Grouping

SCIS . . . . Material Objects

EIS . . . . Groups

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- observe objects, living things, and happenings in their environments
- make guesses about the happenings in their environments
- identify properties and attributes of materials to group or categorize data
- discover similarities and differences among materials, substances, and their properties

Content Area:

Living things are interdependent with one another and with their environment.

Substantive Topic (Suggested Level):

Environmental Differences (Level K)

Activity (Title and Description):

Investigating Animals (CIS, Yellow)

As children study animals, they observe the likenesses and differences. Many environments should be included so children can observe many varieties of animals in their own environment such as fish, snails, gerbils, etc. They should observe the breathing, feeding, growing, and the mobility of various animals. The children will group animal pictures according to likenesses learned from observations.

Behavioral Performance Objectives:

The child will describe how animals get air, eat, reproduce, and move about by observing animals in the classroom, park, zoo, or in their natural habitat.

The child will distinguish the rate of growth by measuring a pet's legs, girth, and weight.

Alternate Activity (Title and Description):

Pets and Other Animals (MCPS)

The children make a list of the needs of pets. The class can then decide on a pet to have in their own classroom. The children work together to meet the needs of their pet animal. One child sees that the animal has enough of the right kind of food, another provides drinking water, while others from the class provide other needs previously listed by the class. The children make sure that their pet's needs have all been met. Following this activity the children visit either a pet shop, park, or zoo to see how the caretaker meets the needs of each animal.

Behavioral Performance Objectives:

The child will describe the needs of a classroom pet.

The child will demonstrate how to care for an animal in the classroom.

The child will describe how caretakers at either the pet shop, park, or zoo meet the needs of animals.

Sources of Additional Activities for Substantive Topic: Environmental Differences

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following source. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Organisms

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- observe objects, living things, and happenings in their environment
- identify properties and attributes of materials to group or categorize data
- discover similarities and differences among materials, substances, and their properties

Content Area:

A living thing is the product of its heredity and environment.

Substantive Topic (Suggested Level):

Needs and Processes of Living Things (Level K)

Activity (Title and Description):

Investigating Plants-Seeds (CIS, Yellow)

The children will be provided opportunities to observe various seeds. The class should be provided time to observe, manipulate, and group seeds. They should group seeds and explain the criteria used to organize their groups. They can compare seeds in a class collection with seeds in pictures or a classroom seed chart where seeds have been identified.

Behavioral Performance Objectives:

The child will describe the likenesses and differences of seeds according to their shape, color, size, and texture.

The child will distinguish seeds by comparing them with charts and pictures.

Alternate Activity (Title and Description):

Investigating Plants-Seed Plants (CIS, Yellow)

The children list the needs of a plant. The class then selects seeds that they can plant in their classroom. The children can observe the root system and the growth of the plant when seeds are planted on moistened blotters or sponges. They should also plant seeds in planters or containers that they can observe each day. The children will learn to care for their plants. They should observe the likenesses and differences of plants as they begin to emerge above the soil.

Behavioral Performance Objectives:

The child will describe the basic needs of living plants.

The child will demonstrate different ways to sprout seeds by planting them on moistened blotter paper or a sponge.

The child will construct a planter in which a seed can be planted and grow.

The child will identify the likenesses and differences of plants.

Sources of Additional Activities for Substantive Topic: Needs and Processes of Living Things

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Organisms

MCPS . . . . Pets and Other Animals

EIS . . . . Life Histories

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- observe objects, living things, and happenings in their environment
- wonder about their environment and ask questions
- investigate by manipulating materials, talking, listening, thinking, and visiting
- identify properties and attributes of various materials to group or categorize data

Content Area:

When energy changes from one form to another, the total amount of energy remains unchanged.

Substantive Topic (Suggested Level):

Forms of Energy (Level 1)

Activity (Title and Description):

Rockets - Action and Reaction (CIS, Blue)

Children investigate ways in which a balloon can be like a rocket. In this activity children observe that when air is put into the balloon it inflates. The children make inferences as to what will happen when the balloon is released at the neck. When air rushes out the neck of the balloon and the balloon moves in the opposite direction, the children guess why it happened. Forces are discussed.

Behavioral Performance Objectives:

The child will describe similarities between the action of a rocket and a model in the form of a long, narrow, inflated balloon.

The child will demonstrate that when air pushes out of the balloon the balloon moves.

The child will describe what happens when the balloon is empty of air.

Alternate Activity (Title and Description):

Magnetic Force (CIS, Blue)

Children will learn about magnetic and gravitational forces. The class learns that magnets come in various shapes. Magnets are identified as ring, bar, and horseshoe magnets. Various types of materials are grouped according to their properties of attraction or nonattraction to the magnet. The class will also experience that objects can be lifted by magnets without touching the objects. Children talk about overcoming the force of gravity.

Behavioral Performance Objectives:

The children will demonstrate that a magnet can be used to pick up metal objects from an array of different metal and nonmetal objects.

By using a magnet to lift some objects without touching, the child will demonstrate that a magnetic force can be used to overcome the force of gravity.

Sources of Additional Activities for Substantive Topic: Forms of Energy

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . Sound

MCPS . . . . Magnets

EIS . . . . Hot and Cold

EIS . . . . Light and Shadow

SCIS . . . . Interactions and Systems

ESS . . . . Spinning Tables

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- build their science vocabulary through manipulative activities involving verbal and nonverbal communication
- develop basic skills in observing, manipulating, organizing, and grouping, those special things that scientists do
- discover similarities and differences among materials to group or categorize data

Content Area:

When matter changes from one form to another, the total amount of matter remains unchanged.

Substantive topic (Suggested Level):

Forms of Matter (Level 1)

Activity (Title and Description):

Solid, Liquid, and Gas (CIS, Blue)

The children will learn about the properties that separate solids, liquids, and gases. The children examine a rock in a plastic bag and determine if the rock takes up space or changes shape. The children examine water in a tumbler. The children determine if the water takes up space or changes shape by pouring the water from one container to another. The children fill a plastic bag with air and determine if the air takes up space or changes shape by squeezing the bag.

Behavioral Performance Objectives:

The child will describe a solid as an object that retains its shape.

The child will demonstrate that a liquid will take the shape of the container it is in.

The child will demonstrate that a gas takes up space by blowing air into a plastic bag, holding the bag shut, and squeezing the bag.

Alternate Activity (Title and Description):

Observing Gases (SCIS, Material Objects)

By observing air, freon-12, and iodine gases, the children discuss the properties of each. The children put freon-12 into balloons and compare the rate of falling with air filled balloons. The children may also observe that iodine gas which comes from iodine crystals is pink-purple in color.

Behavioral Performance Objectives:

The children will describe different properties of air, freon-12, and iodine gas.

Sources of Additional Activities for Substantive Topic: Forms of Matter

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . Grouping

EIS . . . . Groups

ESS . . . . Attribute Games and Problems

ESS . . . . Sand

ESS . . . . Drops, Streams and Containers

ESS . . . . Pattern Blocks

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- relate previous experience to new situations
- develop a positive self-concept and see themselves as worthy and acceptable individuals who have worthwhile contributions to make to the group
- increase their awareness of the interrelationship of plants, animals, and the physical environment

Content Area:

Living things are interdependent with one another and with their environment.

Substantive Topic (Suggested Level):

Effect of Environment on Living Things (Level 1)

Activity (Title and Description):

Plants in Good and Poor Environments (CIS, Blue)

The children soak 18 radish seeds in water overnight to speed up germination. The children then put soil in 6 cone-shaped paper cups, numbering them from 1 through 6. The children pour water in tumblers numbered 1 through 3 until the water touches the paper cone in the tumbler. The children do not water tumblers numbered 4 to 6. The children then discuss the environmental conditions of their activity. After the seeds have sprouted in tumblers 1, 2, and 3, the children discuss the reason why the seeds in tumblers 4, 5, and 6 have not sprouted.

Behavioral Performance Objectives:

The child will demonstrate that water is essential for survival of living plants by planting radish seeds in vermiculite, watering some with sufficient water, and some with insufficient water.

Alternate Activity (Title and Description):

Observing Organisms and Where They Live (SCIS, Organisms)

The children in small groups explore the area around the school. The children will look for as many different kinds of animals and plants as they can find and notice where they live. The children may observe that some animals while not present at this time left signs of their presence. The children will return to the classroom and discuss their findings. The pupils will do an activity such as a language experience chart for a record of their experience.

Behavioral Performance Objectives:

The child will describe the environment necessary for one plant and one animal they have discovered around the school site.

Sources of Additional Activities for Substantive Topic: Effect of Environment on Living Things

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Organisms

EIS . . . . Plants in Spring

ESS . . . . Growing Seeds

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- express their own ideas about their observations
- select the hypothesis which offers the best explanation to a problem
- communicate descriptions of activities and their results
- use with understanding science words appropriate to their level of maturity

Content Area:

A living thing is the product of its heredity and environment.

Substantive Topic (Suggested Level):

Reproduction (Level 1)

Activity (Title and Description):

New Plants From Seeds (CIS, Blue)

The children plant beet, oat, and pea seeds in vermiculite. The seeds are spaced around a plastic cone with holes in it to allow water to penetrate to the vermiculite. The cone is then placed into a tumbler. The children then pour plant food solution through the vermiculite until one-fourth of the cone is submerged. They discuss how the solution got through the cone into the tumbler. The tumbler is then placed in a warm location where it will receive light. While the children are waiting for the plants to grow, they can bring in various seeds for a display (tomato, pumpkin, watermelon, orange, etc.). The tumbler is examined daily and changes are noted.

Behavioral Performance Objectives:

The child will demonstrate that certain seeds will produce certain plants by planting three types of seeds and observing the plants that grow from these seeds.

Alternate Activity (Title and Description):

Life of Beans and Peas (ESS)

The children plant bean seeds and pea seeds in separate containers. As the seeds germinate and grow, the children keep a picture record of the plants. The children observe the flowering plants and then the formation of the fruit.

The children then plant seeds from their bean and pea plants. The children then observe the growth of their second generation plants and compare them with their picture charts from their first planting.

Behavioral Performance Objectives:

The child will demonstrate that bean seeds will produce bean plants, and pea seeds will produce pea plants by growing beans and peas.

Sources of Additional Activities for Substantive Topic: Reproduction

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Organisms

EIS . . . . Plants in Spring

EIS . . . . Young Animals

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- develop an awareness of the variety among things and some relationships between things in their environment
- identify time/space and material objects in an ordered sequence and recognize interrelationship of organisms to their environment
- develop awareness of things in their environment that can be explained through use of their senses and on the basis of the orderliness of nature

Content Area:

Living Things Are in Constant Change

Substantive Topic (Suggested Level):

Forms of Life (Level 1)

Activity (Title and Description):

Sprouting Seeds (CIS, Blue)

The children examine soaked bean seeds with a magnifier to find the baby plant or embryo. Some of the soaked beans will be placed between a moistened blotter and the inside of a clean tumbler to see if germination occurs. The children will observe daily changes of the seeds. The class makes records of the growth that takes place from seeds that germinate.

Behavioral Performance Objectives:

The child will demonstrate that a new plant sprouts from a dried lima bean when it has been soaked in water and kept moist for several days.

Alternate Activity (Title and Description):

Birth and Growth of Guppies and Snails (SCIS, Organisms)

Daily observations are made of a tank in which guppies and snails have been introduced. The children compare baby guppies with adults and discuss changes during the life cycle. Snail eggs can be observed on the sides of the tank throughout their hatching process. The children study life cycles by comparing animals that have live young with animals that hatch from eggs.

Behavioral Performance Objectives:

The child will observe growth changes in guppies by comparing young with the adults in the tank through the complete life cycle.

The child will recognize changes in the snail eggs as a part of the life cycle.

Sources of Additional Activities for Substantive Topic: Forms of Life

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . Seeds

SCIS . . . . Organisms

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- make guesses about the happenings in their environment
- learn to accept evidence about events in making conclusions
- practice skills and identify terms effective in finding relationships in a variety of materials or objects and their interaction
- discuss and record their science observations and experiences

Content Area:

The universe is in constant change.

Substantive Topic (Suggested Level):

Earth and Daily Changes (Level 1)

Activity (Title and Description):

Light for the Moon (CIS, Blue)

The pupils use a flashlight and mirrors to show that light can be reflected. This idea is then transferred to a model consisting of a balloon as the earth and a flashlight as the sun. The pupils simulate the movements of the earth and moon and observe the changes in reflected light.

Behavioral Performance Objectives:

The child will demonstrate the sun-earth-moon light relationship by shining a flashlight beam against a ball causing it to reflect light to a balloon representing the earth.

Alternate Activity (Title and Description):

Where Is the Moon (ESS)

The children experience an informal introduction to the study of astronomy. Outdoor evening observations take place over a long period of time. Picture records will be kept of the observations of the sky showing the position of the moon and planets. From the pictures, predictions can be made for the position of the moon from month to month.

Behavioral Performance Objectives:

The child will observe the moon over a period of time and predict its future position by drawing a picture of where the moon is at that time and a picture of where it should be two weeks from now.

Sources of Additional Activities for Substantive Topic: Earth and Daily Changes

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS . . . . Earth and Sun

EIS . . . . Weather

ESS . . . . Light and Shadow

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- investigate by manipulating materials, talking, listening, thinking, and reading
- make guesses about the happenings in their environment
- learn to accept evidence about events in making conclusions
- search for more information about material objects and their interaction
- build their science vocabulary through manipulative activities involving verbal and nonverbal communication

Content Area:

When energy changes from one form to another, the total amount of energy remains unchanged.

Substantive Topic (Suggested Level):

Energy Changes (Level 2)

Activity (Title and Description):

How Does a Flashlight Work (CIS, Red)

Through manipulation children will learn that a cell can cause a light bulb to light when a wire is connected in the proper way. By disassembling a flashlight, children will learn that the flashlight does the same job as their wire did. This activity will allow children the opportunity to learn about stored electrical energy and circuitry.

Behavioral Performance Objectives:

The child will construct a circuit using a dry cell, wires, and a lamp, causing the lamp to light.

The child will describe how a flashlight works by disassembling one and observing the components in relation to a circuit.

Alternate Activity (Title and Description):

Electronic Circuits (SCIS, Interaction and Systems)

This activity will give the pupils an opportunity to explore the interaction between a flashlight bulb, wire, an electric motor, a bulb socket, a cell holder, and an electric cell of 1-1/2 volts. Using the equipment the children discover circuits can be used to make the bulb light and the motor run. Systems of one or more circuits can be constructed and the children observe the interaction of these circuits.

Behavioral Performance Objectives:

The child will demonstrate that a system containing a bulb, wire, and a 1-1/2 volt cell will cause a bulb to light.

The child will demonstrate a complete circuit using a light bulb and a motor in the same circuit.

Sources of Additional Activities for Substantive Topic: Energy Changes

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Mirror Cards

EIS . . . . Magnets

EIS . . . . Batteries

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

. investigate by manipulating materials, talking, listening, thinking, and reading
. make guesses about the happenings in their environment
. indicate an awareness of scientists and their achievements through dramatization of stories and role playing

Content Area:

When matter changes from one form to another, the total amount of matter remains unchanged.

Substantive Topic (Suggested Level):

Matter and Motion (Level 2)

Activity (Title and Description):

A Spinning Wheel From Steam (CIS, Red)

The children observe the changes in water when it is heated. The pupils discuss the bubbles that rise from the bottom of the flask as evidence of change. The teacher then places a two-holed rubber stopper on top of the flask. The children observe the water vapor escaping from the two holes. The teacher then places a bladed wheel on a pivot above the stopper. The pupils observe and discuss their observations.

Behavioral Performance Objectives:

The child will state that heating water to a boil causes water to change to water vapor.

The child will describe how water vapor converted to steam acts effectively as a force to accomplish work.

Alternate Activity (Title and Description):

Making Copper Chloride Solution: (SCIS, Interaction and Systems)

The pupils place copper chloride in water and observe the interaction. The children observe that the crystals get smaller and the water gets bluer. The children then allow some of the solution to evaporate and observe another change. The copper chloride has not disappeared but has changed back to a crystal. A record is kept by the pupils as they describe the system of interacting objects by making a picture story.

Behavioral Performance Objectives:

The child will demonstrate by allowing a solution of copper chloride to evaporate that the copper chloride used to make the solution has not disappeared but is only in a different form.

Sources of Additional Activities for Substantive Topic: Matter and Motion

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS . . . . Air

EIS . . . . Balances

ESS . . . . Primary Balancing

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- develop an awareness of the variety among things and some relationships between things in their environment
- recognize interrelationships of organisms to their environment
- relate to their environment through group activities and interrelationships that recognize them as individuals with both responsibilities and privileges in the group
- observe the presence of a variety of living and nonliving things as part of their own ecosystem
- develop awareness of things in their environment that can be explained through the use of their senses and on the basis of the orderliness of nature

Content Area:

Living things are interdependent with one another and with their environment.

Substantive Topic (Suggested Level):

Environmental Conditions for Life (Level 2)

Activity (Title and Description):

What Happens to Planted Seeds (CIS, Red)

The children begin with a dish containing radish and grass seeds. The children determine how the seeds are alike and how they are different. For each group of children, two dishes with sponges and blotters are needed. The children place four grass seeds and four radish seeds on the blotters. The blotters are placed on the sponges in plastic dishes. The children will water one dish and not the other to see if water is necessary for plant germination. A daily picture chart will be drawn by the children to show their observations.

Behavioral Performance Objectives:

The child will demonstrate that seeds need water by planting two sets of seeds and watering one set and not another.

Alternate Activity (Title and Description):

Growing Seeds (ESS)

The children will learn to identify seeds when mixed with other objects after learning the characteristics of seeds. The pupils learn to identify a seed in relation to what it does and keep a record (strip graph) of the growth of their seedlings.

Behavioral Performance Objectives:

The child will identify and group various types of seeds when mixed with nonseed objects.

Sources of Additional Activities for Substantive Topic: Environmental Conditions for Life

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Life Cycle

MCPS . . . . Plants

EIS . . . . Living Things

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- investigate by manipulating materials, talking, listening, thinking, and reading
- identify properties and attributes of materials to group or categorize data
- discover similarities and differences among materials, substances, and their properties
- practice skills and identify terms in finding relationships in a variety of materials, objects, and organisms
- discuss and record their science observations and experiences

Content Area:

A living thing is the product of its heredity and environment.

Substantive Topic (Suggested Level):

Life Cycles (Level 2)

Activity (Title and Description):

How Do Seedlings Differ (CIS, Red)

By growing various plants (corn, kidney beans, soybeans, and wheat), children will observe that there are likenesses and differences in seedlings. Children will learn that roots and stems of seedlings behave in a like manner. They observe that seeds that are alike will produce plants that are alike, and that plants can be grouped according to their characteristics.

Behavioral Performance Objectives:

The child will demonstrate that grass plants grow from grass seeds illustrating that an organism is the product of its heredity.

The child will demonstrate that each organism gives rise to its own kind by planting bean and corn seeds.

The child will distinguish between growing bean and corn seedlings by observing their characteristics.

Alternate Activity (Title and Description):

Plant Life Cycles (SCIS, Life Cycles)

The children will plant seeds and observe the growth of squash, sunflower, corn, and marigold. The children will plant bean seeds and pea seeds. They will discuss properties of each. The children will take daily measurements, draw pictures of observed changes, and record growth rate of their various plants in graphic form.

Behavioral Performance Objectives:

The child will identify the major parts of plants.

The child will arrange in order pictures of plants in various stages of growth.

Sources of Additional Activities for Substantive Topic: Life Cycles

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Brine Shrimp

ESS . . . . Life of Beans and Peas

MCPS . . . . School Grounds as a Site for Inquiry

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- observe objects, living things, and happenings in their environment
- investigate by manipulating materials, talking, listening, thinking, and reading
- make guesses about their environment
- identify properties and attributes of materials, substances, and their properties

Content Area:

Living Things Are in Constant Change

Substantive Topic (Suggested Level):

Extinct Life (Level 2)

Activity (Title and Description):

What Do We Learn From Fossils? (CIS, Red)

The pupils organize an investigation comparing fresh shells and a shell that has been fossilized. The children identify the function of the fossils. The class uses clay or mud to make models of how fossils were formed. The children identify fossils as plant or animal in origin and observe how living things may have looked long ago.

Behavioral Performance Objectives:

The children will demonstrate how a fossil could have been formed by putting an object between clay to get an impression.

The children will identify fossil remains as having resulted from either plants or animals.

Alternate Activity (Title and Description):

Genetic Identity (SCIS, Life Cycles)

The children investigate how a certain kind of plant grows from a certain kind of seed.

The children identify sunflower, squash, corn, and marigold seeds from pictures. After planting the seeds, the children will identify the seedlings that grow by comparing the seedlings with pictures.

Behavioral Performance Objectives:

The child will identify growing plants as sunflowers, squash, corn, or marigolds when shown pictures of these plants.

The child will demonstrate that a certain plant will grow from certain seeds by planting known seeds and observing the growth of the seedlings.

Sources of Additional Activities for Substantive Topic: Extinct Life

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Brine Shrimp

ESS . . . . Butterflies

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: K/2

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- wonder about their environment and ask questions
- develop basic skills in observing, manipulating, organizing, and grouping, those special things scientists do
- build their science vocabulary through manipulative activities involving verbal and nonverbal communication

Content Area:

The universe is in constant change.

Substantive Topic (Suggested Level):

Movements of Earth and Moon (Level 2)

Activity (Title and Description):

Why Does the Moon's Shape Seem to Change? (CIS, Red)

The children will use a light bulb and a plastic ball to discover why the moon appears to change shape. With the lighted bulb (sun) in a fixed position one child holding the plastic ball (moon) walks around a second child to simulate the revolving moon. The second child represents the earth and will observe the changes in the sun's reflection on the moon.

Behavioral Performance Objectives:

The child will demonstrate how the lighted areas of the moon change shape.

Alternate Activity (Title and Description):

Making Shadow Records (ESS, Daytime Astronomy)

The children will make a large shadow stick to chart the position of the shadows from the sun. In addition the children will make an individual shadow stick out of a small square of wood and a golf tee or a stick of approximate size. The children will observe and record the daily, weekly, and monthly changes in the position of the shadows.

Behavioral Performance Objectives:

The child will observe and record the changes in the shadow cast by the sun on a shadow stick over a period of three weeks.

From their records the child will predict the approximate weekly position of the spot where the shadow will fall from their shadow stick.

Sources of Additional Activities for Substantive Topic: Movements of Earth and Moon

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Interaction and Systems

ESS . . . . Where Is the Moon?

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- investigate by manipulating materials and recording their results in tables, diagrams, graphs, and charts
- use with understanding science words appropriate to their level of maturity
- demonstrate that science is an orderly process involving cause and effect relationships perceivable through investigation by human beings

Content Area:

When energy changes from one form to another, the total amount of energy remains unchanged.

Substantive Topic (Suggested Level):

Radiant Energy (Level 3)

Activity (Title and Description):

Electromagnets (CIS, Green)

Using a dry cell, nail, and copper wire, the children will construct an electromagnet. Through investigation of these materials, the children will discover that an electromagnet is formed only when the wire is wound around the nail. This investigation will lead to further experimenting and testing of electromagnets such as ringing a door bell, making an electric motor, and exploring solar energy.

Behavioral Performance Objectives:

The child will construct an electromagnet using a dry cell, a length of insulated copper wire, and a large nail.

The child will demonstrate that electric energy can make things move by using the electromagnet to lift paper clips.

The child will state that the nail acts as a magnet only when it is in a coil of wire.

Alternate Activity (Title and Description):

Electric Circuit Puzzles (SCIS, Subsystems and Variables)

The children will investigate puzzle circuits and make inferences about the wiring patterns of circuits. Through this investigation they will be able to make inferences about the wiring patterns. They will make diagrams about their inferences which they will check together in class discussion.

Behavioral Performance Objectives:

The child will test the circuit puzzle for electrical interaction and record his results in the student manual.

The child will chart systems and subsystems of the circuit puzzles in the student manual.

Sources of Additional Activities for Substantive Topic: Radiant Energy

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS . . . . Heat

EIS . . . . Motion

EIS . . . . Sound

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- express their own ideas about their observations
- make choices and draw conclusions from evidence obtained
- improve their skills in reorganizing ideas in the light of new information
- see that while change is continuous there are cycles and patterns that give a degree of stableness that insures predictability of events important in the lives of men

Content Area:

When matter changes from one form to another, the total amount of matter remains unchanged.

Substantive Topic (Suggested Level):

Structure of Matter (Level 3)

Activity (Title and Description):

Weight of Water and Ice (CIS, Green)

The children will construct hypotheses about how water can be changed. The children will place water in a plastic bag, weigh it, and then freeze the water. The frozen water will be weighed, melted, and weighed again as water. The children observe that the weight of water does not change when it freezes.

Behavioral Performance Objectives:

The child will demonstrate that the weight of water does not change as water changes from liquid to solid by weighing a measured amount of water, freezing it, and weighing it again as ice.

Alternate Activity (Title and Description):

Liquid and Gaseous Freon (SCIS: Subsystems and Variables)

Liquid freon will be placed in a sealed plastic bag. The children will warm the liquid with their hands and observe the change from liquid to gas. After some discussion the bag will be cooled with ice cubes and the gas will be condensed back into a liquid. From observing this cycle, the children will be able to draw conclusions about changes in the state of matter (liquid to gas and gas to liquid).

Behavioral Performance Objectives:

The child will demonstrate that freon can change from liquid to gas and back to a liquid through direct interaction of energy.

The child will demonstrate that freon in gaseous state requires more space than freon in liquid state by placing liquid freon in a closed plastic bag and heating it to form a gas, causing the bag to inflate.

Sources of Additional Activities for Substantive Topic[illegible]ructure of Matter

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS . . . . Chemical Changes

ESS . . . . Mystery Powders

ESS . . . . Match and Measure

ESS . . . . Printing

ESS . . . . Mobiles

ESS . . . . Changes

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- recognize a problem
- organize their scientific findings in lists, pictures, diagrams, models, reports, summaries, exhibits, collections, and stories
- communicate descriptions of activities and their results
- begin to select data which are pertinent to the problem

Content Area:

Living things are interdependent with one another and their environment.

Substantive Topic (Suggested Level):

Environments and Related Living Forms (Level 3)

Activity (Title and Description):

The Nature of Soil (CIS, Green)

The activity will involve the children in an investigation of a soil sample. After discussion of the task centering on the nature of particles such as pebbles, clay, sand, leaves, twigs, etc., the children will separate the soil sample into particles. The children will be encouraged to consider the usefulness of soil by describing its characteristics and functions.

Behavioral Performance Objectives:

The child will demonstrate that soil is made up of different materials by separating a sample into three or more parts.

The child will name three properties of pebbles, clay, sand, leaves, and twigs as they relate to the nature of soil.

Alternate Activity (Title and Description):

Food Chains (SCIS, Populations)

This activity will encourage the children to explore the concept of a food chain. The children are led to discover that all food chains begin with plants. After group discussion the children are given a pond picture and asked to identify as many food chains as they can. The children should realize that each food chain consists of a plant, a plant eater, and an animal eater.

Behavioral Performance Objectives:

The child will demonstrate his understanding of food chains by diagraming sample food chains.

Sources of Additional Activities for Substantive Topic: Environments and Related Living Forms

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . Habitats

EIS . . . . Plant and Animal Response

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- express their own ideas about their observations
- select the hypothesis which offers the best explanation to a problem
- relate previous experience to new situations
- evaluate their efforts and continue to strive for improvement by setting new standards

Content Area:

A living thing is the product of its heredity and environment.

Substantive Topic (Suggested Level):

Classification of Living Things (Level 3)

Activity (Title and Description):

What Has Changed?(CIS, Green)

The children will make observations of the differences between six pebbles and six beans. Half of the pebbles and beans will be placed in boiling water. The children will look for changes and describe differences in the heated beans and pebbles. All pebbles and beans will be planted to observe if there are any differences between pebbles boiled, pebbles unboiled, beans boiled, and beans unboiled. During this investigation the children will have the opportunity to make hypotheses which they will test.

Behavioral Performance Objectives:

The child will describe properties that distinguish between two objects by listing three or more differences in the objects after they have been boiled.

The child will demonstrate that lima beans are living things and may be killed by extremes such as heat.

The child will distinguish lima beans as living things from pebbles as nonliving things.

Alternate Activity (Title and Description):

Factors in Germination and Growth (ESS, Life of Beans and Peas)

The children will select a variety of seeds to sprout and plant. The children will choose a number of environmental variables to involve in their studies. These variables will be listed at planting time. Results with different seeds can be described in relation to the variables used at planting.

Behavioral Performance Objectives:

The child will describe differences in beans by listing three or more characteristics of the seeds he planted.

The child will demonstrate that certain seeds produce plants and others do not.

Sources of Additional Activities for Substantive Topic: Classification of Living Things

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Populations

ESS . . . . Brine Shrimp

EIS . . . . Life Histories

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- investigate by manipulating materials and recording their results in tables, diagrams, graphs, and charts
- make choices and draw conclusions from evidence obtained
- recognize variety, time, space, adaptation, balance, and interrelationships
- increase their awareness of the interrelationships of plants, animals, and the physical environment

Content Area:

Living things are in constant change.

Substantive Topic (Suggested Level):

Environmental Changes (Level 3)

Activity (Title and Description):

Developing a Balanced Environment for Guppies (CIS, Green)

The children will visit a pond and determine the characteristics of the environment. Using a small aquarium, or other glass container (such as a gallon jar) the class will set up a community including guppies, snails, and anacharis. The children should see from their visit to the pond that they must include many plants for each animal. They should also have identified light and temperature as characteristics of the environment. Therefore, the aquarium should be placed in the sun. The children will record the changes that take place within the environment. Changes should be noted in the temperature of water as well as the fish, snail, and plant populations.

Behavioral Performance Objectives:

The child will demonstrate a balanced environment by setting up an aquarium with fish, snails, and plant life and observe the interaction.

The child will count and record changes in numbers of each species within an aquarium to demonstrate that changes take place within an aquatic environment.

Alternate Activity (Title and Description):

Daphnia Population (SCIS, Populations)

This activity will use a population of daphnia. The children will consider the increase or decrease of the population in relation to conditions in the containers.

Their observations will reinforce the idea that the size of a population depends on the number of young born in relation to the number of deaths. Over a given period of time, the students will determine that the number of births and deaths varies depending on the conditions of the environment. The children will count and keep records of numbers of daphnia. As populations grow to large numbers, the children will estimate population size. They will show their results pictorially or graphically.

Behavioral Performance Objectives:

The child will describe the effects of the environment on daphnia by estimating the increase and decrease in numbers.

The child will predict what will happen to the daphnia in the environment in one week, two weeks, and three weeks.

Source of Additional Activities for Substantive Topic: Environmental Changes

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following source. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . School Grounds as a Site for Inquiry

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- improve their skills in reorganizing ideas in the light of new information
- use with understanding science words appropriate to their level of maturity
- develop a positive self-concept and see themselves as worthy and acceptable individuals who have worthwhile contributions to make to the group
- identify some of the ideas and discoveries of men and women in science who have made significant contributions to our body of knowledge

Content Area:

The universe is in constant change.

Substantive Topic (Suggested Level):

Solar System and Change (Level 3)

Activity (Title and Description):

Relative Distances of the Planets (CIS, Green)

The children will use this activity to understand better the distances between the planets. The children will work on the playground to establish an idea showing Mercury to be 280 feet from the sun. Pluto would then be 3-1/2 miles away. The children then can shrink the model by 100 times and mark out distances of the nine planets. The children will construct cardboard models of each planet and display them in their relative positions. (The scale for the sizes of the planets will be different from that used for the distances.)

Behavioral Performance Objectives:

The child will demonstrate that distances between the nine planets can be shown on a model.

The child will describe the relative distances of the nine planets by placing a carboard model on a scale model of the solar system.

Alternate Activity (Title and Description):

The Sun (MCPS, Earth in Space)

In this activity the children will be gaining information about the changing position of the sun at various times of the day. A long stick will be used to cast a shadow. Using a predetermined time schedule, the children will make a mark at the end of the shadow. Using this procedure the children will discover that the sun's position in the sky changes throughout the day. To record their findings, the children can make drawings which show their discoveries.

Behavioral Performance Objectives:

The child will demonstrate that the position of the sun in the sky changes during the day by marking the position of a shadow at different times of the day.

The child will observe the sun's movement and record it in a picture series.

Source of Additional Activities for Substantive Topic: Solar System and Change

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following source. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Earth, Sun and Seasons

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- express their own ideas about their observations
- improve their skills in reorganizing ideas in the light of new information
- communicate descriptions of activities and their results
- demonstrate that science is an orderly process involving cause and effect relationships perceivable through investigation by human beings

Content Area:

When energy changes from one form to another, the total amount of energy remains unchanged.

Substantive Topic (Suggested Level):

Energy and Motion (Level 4)

Activity (Title and Description):

Investigation Into Water Droplets (CIS, Orange)

The children will use glass jars, tape, water, cooking pan, hot plate, and magnifying glass to investigate water vapor and condensation. Water will be heated in an enclosed area to cause evaporation and condensation. After close observation of this natural process, the children will express their ideas in explaining what happened.

Behavioral Performance Objectives:

The child will demonstrate evaporation and condensation of water droplets.

The child will make inferences about the evaporation-condensation cycle.

The child will describe interaction of condensed water drops in a glass chamber.

The child will manipulate a magnifying glass to observe better what happens.

Alternative Activity (Title and Description):

How Can You Make an Ice Cube Melt Faster Than it Does in Air? (Ess, Ice Cubes)

The children will be encouraged to discuss ways in which ice will melt at different rates. From this discussion the children will make hypotheses. The children will be able to use ice cubes and attempt to melt them more rapidly than those exposed to the air. Information gained will be used to support or refute their hypotheses by ordering the events and describing their results.

Behavioral Performance Objectives:

The child will formulate a hypothesis about increasing the rate of ice melting.

The child will invent a way to hasten the melting rate of the ice cube.

The child will record data about the interactions of ice and its environment.

Sources of Additional Activities for Substantive Topic: Energy and Motion

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . Melting Ice

SCIS . . . . Relative Position and Motion

EIS . . . . Solids, Liquids, Gases

ESS . . . . Musical Instrument Recipe Book

ESS . . . . Heating and Cooling

ESS . . . . Whistles and Strings

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- recognize a problem
- investigate by manipulating materials and recording their results in tables, diagrams, graphs, and charts
- begin to select data which are pertinent to the problem
- recognize variety, time, space, adaptation, balance, and interrelationships

Content Area:

When matter changes from one form to another, the total amount of matter remains unchanged.

Substantive Topic (Suggested Level):

Chemical Changes (Level 4)

Activity (Title and Description):

Oxygen and Air (CIS, Orange)

The children will compare the rusting of steel wool in an environment of air versus one of oxygen. They will place wet steel wool in the bottoms of two test tubes. The test tubes will be inverted with their opening placed in water. Oxygen from a hydrogen peroxide-yeast mix will be collected in one test tube with air trapped in the other. The children will observe the rate of rusting in the two samples and the change in height of the water level in each tube.

Behavioral Performance Objectives:

The child will demonstrate a process for collecting of oxygen from a hydrogen peroxide-yeast mix.

The child will demonstrate that steel wool rusts more quickly in oxygen than in air.

The child will demonstrate that the rusting of wet steel wool placed in the bottom of a test tube inverted with the opening resting in water will cause the water level to rise inside the tube.

Alternate Activity (Title and Description):

Interaction with Vinegar (ESS, Mystery Powders)

The children will use five mystery powders: starch, baking soda, sugar, plaster of paris, and salt. They will add vinegar to each powder and observe the reaction. The reactions will be recorded on a chart. Comparisons will be made. The children will select properties involved in the interactions and give their ideas about what changes take place.

Behavioral Performance Objectives:

The child will demonstrate that vinegar reacts differently on starch, baking soda, sugar, plaster of paris, and salt.

The child will record his observations on a chart.

The child will use the chart to interpret results and demonstrate that he is able to ascribe properties to different substances.

Sources of Additional Activities for Substantive Topic: Chemical Changes

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS . . . . Chemical Changes

ESS . . . . Clay Boats

ESS . . . . Sink or Float

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- relate previous experience to new situations
- organize their scientific findings in lists, pictures, diagrams, models, reports, summaries, exhibits, collections, and stories
- communicate descriptions of activities and their results
- develop a positive self-concept and see themselves as worthy and acceptable individuals who have worthwhile contributions to make to the group

Content Area:

Living things are interdependent with one another and their environment.

Substantive Topic (Suggested Level):

Exchange Between Living Things and Environment (Level 4)

Activity (Title and Description):

A Piece of Bread (CIS, Orange)

The children will grow mold on bread. The activity will involve placing moist bread in a closed container and allowing mold to grow. The mold will be studied under a magnifying glass. From this activity the children will determine the nature of mold growth. They will make simple diagrams of the mold.

Behavioral Performance Objectives:

The child will demonstrate that bread will diminish in size as the mold begins to grow.

The child will observe and describe the growth of mold on bread by listing five properties.

The child will make inferences that the mold is using the bread as food for its growth and that the bread will disappear in time.

Alternate Activity (Title and Description):

A Place to Live (SCIS, Environments)

The children construct a terrarium with a set population of no more than ten beans, six isopods, six beetles, and three snails. In each terrarium, include at least one organism of each kind, and keep all organisms inside the container.

Behavioral Performance Objectives:

The child will record, over a period of time, the changes within the terrarium population.

Sources of Additional Activities for Substantive Topic: Exchange Between Living Things and the Environment

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS	. . . . Ecology
MCPS	. . . . School Grounds as a Site for Inquiry
EIS	. . . . Adaptations
ESS	. . . . Earthworms

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- select the hypothesis which offers the best explanation to a problem
- relate previous experience to new situations
- make choices and draw conclusions from evidence obtained
- improve their skills in reorganizing ideas in the light of new information

Content Area:

A living thing is the product of its heredity and environment.

Substantive Topic (Suggested Level):

Environment and Reproduction (Level 4)

Activity (Title and Description):

A Food Supply (CIS, Orange)

Pond water will be used in this activity. The children will organize an investigation using two containers of pond water. In one container the children will add either uncooked rice or cooked egg yolk as food for bacteria. Nothing will be added to the other container. After a week the children will examine their samples with the aid of a magnifying glass. The children may then construct inferences about changes that have occurred in the different samples.

Behavioral Performance Objectives:

The child will demonstrate that a food supply is necessary for organisms to grow and multiply by placing a food supply in a sample of muddy pond water and comparing the growth within the sample to one without a food supply.

Alternate Activity (Title and Description):

Brine Shrimp in Salt Water (SCIS, Environments)

The children will use a salt water solution to hatch brine shrimp eggs. The children will set up five vials with different strengths of salt solution. They will place a small amount of brine shrimp eggs into each vial. After four to seven days, the children will determine the hatching rate for each vial. They determine if most, some, or none of the eggs hatched. A chart will be constructed to show the findings of their study.

Behavioral Performance Objectives:

The child will demonstrate that brine shrimp hatch at different rates in differing strengths of salt water solution by experimenting with five different solutions and constructing a chart to record observations.

Source of Additional Activities for Substantive Topic: Environment and Reproduction

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following source. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Mosquitoes

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- organize their scientific findings in lists, pictures, diagrams, models, reports, summaries, exhibits, collections, and stories
- use with understanding science words appropriate to their level of maturity
- increase their awareness of the interrelationships of plants, animals, and the physical environment
- see that while change is continuous there are cycles and patterns that give a degree of stableness that insures predictability of events important in the lives of men

Content Area:

Living things are in constant change.

Substantive Topic (Suggested Level):

Living Things and Environmental Changes (Level 4)

Activity (Title and Description):

Where Green Plants Will Grow (CIS, Orange)

The children will grow plants in different environments. These environments will differ by the addition of such things as salt, vinegar, or heat. A record will be kept of the watering rate, addition of other substances, and rise and decline in temperature. These records will be compared with the individual plants in each environment to draw conclusions about where green plants will grow.

Behavioral Performance Objectives:

The child will demonstrate the conditions under which green plants will grow best by growing seeds under six different conditions of soil, water, and light.

Alternate Activity (Title and Description):

From Egg to Frog (ESS, Eggs and Tadpoles)

Children observe changes of frog eggs as they develop into tadpoles and then into frogs. The children gain direct experience with this biological function as they work with the organisms. Observations and discussions about each stage of change will develop an understanding of this cycle.

Behavioral Performance Objectives:

The child will demonstrate that frogs' eggs will go through several stages of change to become adult frogs by observing the changes in a classroom environment and making charts, graphs, or drawings to show what they have observed.

Sources of Additional Activities for Substantive Topic: Living Things and Environmental Changes

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Animal Activities

ESS . . . . Animals in the Classroom

SCIS . . . . Environments

Band: 3/4

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

. express their own ideas about their observations
. recognize a problem
. select the hypothesis which offers the best explanation to a problem
. evaluate their efforts and continue to strive for improvement by setting new standards
. identify some of the ideas and discoveries of men and women in science who have made significant contributions to our body of knowledge

Content Area:

The universe is in constant change.

Substantive Topic (Suggested Level):

Celestial Bodies and Motion (Level 4)

Activity (Title and Description):

The Changing Shape of the Moon (CIS, Orange)

This activity will provide the children with concrete evidence about the phases of the moon. The children will use a ball and a light source to illustrate how the lighted side of a sphere changes shape at different positions. The children will generalize the information gained from this experience to the concept of phases of the moon.

Behavioral Performance Objectives;

The child will demonstrate how the moon's shape seems to change by holding a ball and walking slowly around an observer while a light source shines on it.

The child will describe that the shape of the lighted part of the ball changes because the ball is moving around the observer.

Alternate Activity (Titl[illegible]d Description):

Rolling Spheres (SCIS, Re[illegible]ve Position and Motion)

In this activity the children will be working with steel spheres. Using carbon paper and plain paper, the children will be able to record the path of the sphere in motion. Variables of size, speed, and motion will be introduced to allow the children to make predictions about motions of steel spheres.

Behavioral Performance Objectives:

The child will demonstrate that spheres in motion will have predictable pathways by rolling different size steel spheres over carbon paper.

Sources of Additional Activities for Substantive Topic: Celestial Bodies and Motion

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS . . . . Atmosphere and Weather

EIS . . . . Geological Processes

Band: 5/6

Selected Outcomes

Students should have experienced activities which enable them, within their individual capabilities, to:

. investigate by recognizing data collecting and using data in solving problems
. identify sets of conditions and recognize that these lead to specific inferences
. recognize as logical the sequence in events such as cause and effect
. express results of data collected in graphs, charts, symbolic forms, and mathematical terms
. acquire scientific information and begin to make meaningful inferences useful in making generalizations

Content Area:

When energy changes from one form to another, the total amount of energy remains unchanged.

Substantive Topic (Suggested Level):

Energy, Force and Motion (Level 5)

Activity (Title and Description):

Constructing a Model Rocket (CIS, Purple)

The children will construct a model rocket by using a sausage shaped balloon, paper, plastic straws, tape, and scissors. They will launch the rocket, observe what happens, record changes in the system, make inferences, and compare their model to a real rocket. They will discover physical properties of materials used in building rockets.

Behavioral Performance Objectives:

The child will make a model to show the action and reaction of a model rocket.

The child will observe the flight of the model rocket and record how and why it works.

The child will demonstrate how the model is like and unlike a real rocket by listing the properties of the materials of the model compared to the real rocket.

Alternate Activity (Title and Description):

Exploring Rotoplane (SCIS, Energy Sources)

The children will construct a simple rotoplane or PRS (propeller, rubber band, stick) system. They will operate the model in a variety of ways. They will observe the happenings during the experiment and will record results so that they can construct a histogram.

Behavioral Performance Objectives:

The child will assemble a rotoplane and describe how it works.

The child will record results in mathematical language which can be developed into a graph.

The child will develop and carry out systematic experiments using variables which will affect the motion of the rotoplane.

Sources of Additional Activities for Substantive Topic: Energy, Force and Motion

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Optics

ESS . . . . Structures

EIS . . . . Unbalanced Forces

ESS . . . . Stream Tables

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- recognize the mechanics involved in problem solving
- formulate their observations into statements of hypothesis
- identify sets of conditions and recognize that these lead to specific inferences
- acquire scientific information and concepts and organize them into meaningful generalizations
- increase their science vocabulary and relate this vocabulary to new situations

Content Area:

When matter changes from one form to another, the total amount of matter remains unchanged.

Substantive Topic (Suggested Level):

Conservation of Matter (Level 5)

Activity (Title and Description):

A First Probe into the Meaning of Testing (CIS, Purple)

Using pink and blue litmus paper and such substances as baking soda, lemon, soap, milk, and water, the children will conduct a series of experiments testing each substance for its acidity or alkalinity. They will record their results on a chart comparing each substance. They should record evidence to support the decision reached about the acid or base characteristics of each substance.

Behavioral Performance Objectives:

The child will identify acids and bases through the interaction of selected substances on blue and pink litmus paper.

The child will record results on a chart classifying each substance as an acid or base.

Given the results of the experiment, the child will be able to make a chart to summarize the data effectively.

Alternate Activity (Title and Description):

Bananas and Yeast (SCIS, Communities)

The children will investigate the interaction of yeast as a decomposer on a banana which has been cut in 1" sections. The children will compare the decomposition of the banana which has been sprinkled with yeast to a section of banana which has not been sprinkled with yeast. The children will keep a daily record of observations of the specimens. They will make inferences in relation to their daily observations. They will develop generalizations about the how and why of the interactions occurring during the investigation.

Behavioral Performance Objectives:

The child will interpret his results by making a chart that demonstrates his ability to use evidence of interaction.

The child will record observations and use the terms raw materials and decomposition in the proper context in reporting results.

Sources of Additional Activities for Substantive Topic: Conservation of Matter

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Energy Sources

ESS . . . . Colored Solution

ESS . . . . Balloons and Gases

ESS . . . . Peas and Particles

ESS . . . . Geo Blocks

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

. observe for the purposes of making inferences
. withhold judgments until they consider all available evidence
. acquire scientific information and begin to make meaningful inferences useful in making generalizations
. recognize and acknowledge a job well done and be aware of feelings of personal satisfaction in their accomplishments and contributions

Content Area:

Living things are interdependent with one another and with their environment.

Substantive Topic (Suggested Level):

Green Plants and Radiant Energy (Level 5)

Activity (Title and Description):

Investigation into the Skeleton of a Leaf (CIS, Purple)

The children will investigate the skeleton and structure of a leaf from a tree by making a "rubbing" of the leaf. They will make a slide of a thin section of a leaf and study the veins and cell shapes. The children will sketch the leaf structure as seen through the microscope.

Behavioral Performance Objectives:

The child will demonstrate his ability to use words such as skeleton and veins by labeling the "rubbing" of the leaf.

The child will describe the leaf structure by attempting to label some of the parts of the cell which he observes through the microscope.

Alternate Activity (Title and Description):

Do Plants Need Light to Grow? (SCIS, Communities)

The children will demonstrate the effect of light on plants. Two separate sets of grass seeds will be planted: one environment will be uncovered so that it will receive natural and artificial light; the second environment will be placed near the first but protected so that the amount of light is controlled. The children will attempt to get both sets of plants to grow at the same rate by altering the amount of light received. They will chart the progress of both environments daily.

Behavioral Performance Objectives:

The child will describe the action of light on grass seed using observations from the chart to list three ways in which a plant depends on light.

Sources of Additional Activities for Substantive Topic: Green Plants and Radiant Energy

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS . . . . School Grounds as a Site for Inquiry

EIS . . . . Starting from Seeds

EIS . . . . Molds

EIS . . . . Microscopic Life

ESS . . . . Microgardening

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- increase their science vocabulary and relate this vocabulary to new situations
- recognize and acknowledge a job well done and be aware of feelings of personal satisfaction in their accomplishments and contributions
- recognize the mechanics involved in problem solving

Content Area:

A living thing is the product of its heredity and environment.

Substantive Topic (Suggested Level):

Cells (Level 5)

Activity (Title and Description):

Investigation into Your Cheek Cells (CIS, Purple)

The children will prepare a slide of their cheek cells by gently scraping the inside of their cheek with the side of a flat toothpick. The children will study the cheek cells using a microscope. The children will stain the specimen so that the structure of the cells can be more clearly seen. They will observe the shape of the cells and locate the nucleus. The children will make a drawing of the cheek cells and write a description of them.

Behavioral Performance Objectives:

The child will demonstrate his ability to use a microscope by locating cheek cells on a prepared slide.

The child will record his observations by making diagrams of cheek cells.

Alternate Activity (Title and Description):

Life in a Drop of Water (ESS, Small Things)

The children will prepare a slide of a drop of water from a pond, puddle, ditch, or creek. They will attempt to find a "creature" and follow it closely. They will study the activities of the creature and will trace its movements by sketching the path it follows. The children will study the structure of some simpler or microscopic animals. Sketching and labeling special structures, they will make records of their observations.

Behavioral Performance Objectives:

The child will demonstrate that life may exist in a drop of water by observing a slide he has prepared from an aquatic habitat that will support living things.

Sources of Additional Activities for Substantive Topic: Cells

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

MCPS	Cells
ESS	Small Things
ESS	Bones
ESS	Pond Water
ESS	Budding Twigs
MCPS	Pond Study
EIS	Microscopic Life

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- investigate by recognizing data collecting and using data in solving problems
- differentiate between reliable and less reliable sources of information and be unafraid to question these sources
- reorganize their ideas in the light of new information

Content Area:

Living things are in constant change.

Substantive Topic (Suggested Level):

Living Things and Time (Level 5)

Activity (Title and Description):

An Investigation into How Bones Fit Together (CIS, Purple)

The children will perform an activity involving the bones of a chicken leg. They will be given the bones of a chicken leg which has been separated. They will be asked to put the bones together properly. The children will record through observations and inferences how the bones fit. They will study the joints and sockets of the chicken leg. They will make a diagram of the chicken leg bone and label all parts. By removing parts of the whole, the children will guess about the missing part. They will discuss this method of guessing the shape of a whole organism from the finding of one or several parts.

Behavioral Performance Objectives:

The child will illustrate how bones fit together by making a diagram and labeling the drawing.

The child will describe through observations and inferences how the process of putting bones together has helped scientists to study the past.

Alternate Activity (Title and Description):

An Investigation into the Adaptations of the Fish (CIS, Purple)

The children prepare an aquarium of sand, water, plants, and guppies. The children observe the adaptation of the fish to life in the water. They will observe the life activities of movement, getting food, getting oxygen. They also observe various phases in the cycle of reproduction. The children will record their observations in a notebook.

Behavioral Performance Objectives:

The child will construct an aquatic environment system by establishing an aquarium containing water, sand, plants, and fish.

The child will describe the adaptations of a fish for such life activities as moving, getting food, getting air and reproducing by observing fish in an aquarium.

Source of Additional Activities for Substantive Topic: Living Things and Time

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following source. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Communities

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- recognize that men of science have made special contributions to the world at large through activities in research and study
- demonstrate that science and technology are products of human endeavor and that in turn man is a product of his heredity and the societal environment
- acquire scientific information and begin to make meaningful inferences useful in making generalizations
- describe and evaluate the role of the scientific enterprise during the history of man

Content Area:

The universe is in constant change.

Substantive Topic (Suggested Level):

Celestial Bodies and Change (Level 5)

Activity (Title and Description):

An Investigation into What a Prism Does to Sunlight (CIS, Purple)

Using a prism and a sheet of white paper, the children will investigate what a prism does to sunlight. They will observe the bands of color, label them, and outline the bands on the white paper. They will observe the path of light entering and leaving the prism.

Behavioral Performance Objectives:

The child will demonstrate that bands of colored light are formed as sunlight passes through a glass prism.

The child will name the color of the bands as red, orange, yellow, green, blue, and violet and the total pattern as a spectrum.

Alternate Activity (Title and Description):

The Colors of Objects (CIS, Purple)

The children will observe the color of objects using a flashlight and cellophane. By placing a square of cellophane over the flashlight, they will observe the color changes of light as it passes through the cellophane to various objects such as the wall. They will record their observations and make inferences related to reasons why color of light changes.

Behavioral Performance Objectives:

The child will demonstrate how the color of light changes as it passes through colored cellophane or transparent plastic.

The child will describe the difference in the color of light by allowing light to pass through different colors of cellophane and transparent plastic.

Sources of Additional Activities for Substantive Topic: Celestial Bodies and Change

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Energy Sources

ESS . . . . Rocks and Charts

EIS . . . . Time

EIS . . . . Mapping

EIS . . . . Balanced Forces

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- reorganize their ideas in light of new information
- observe for the purposes of making inferences
- formulate their observations into statements of hypothesis
- identify sets of conditions and recognize that these lead to specific inferences
- withhold judgments until they consider all available evidence
- express results of data collected in graphs, charts, symbolic forms, and mathematical terms

Content Area:

When energy changes from one form to another, the total amount of energy remains unchanged.

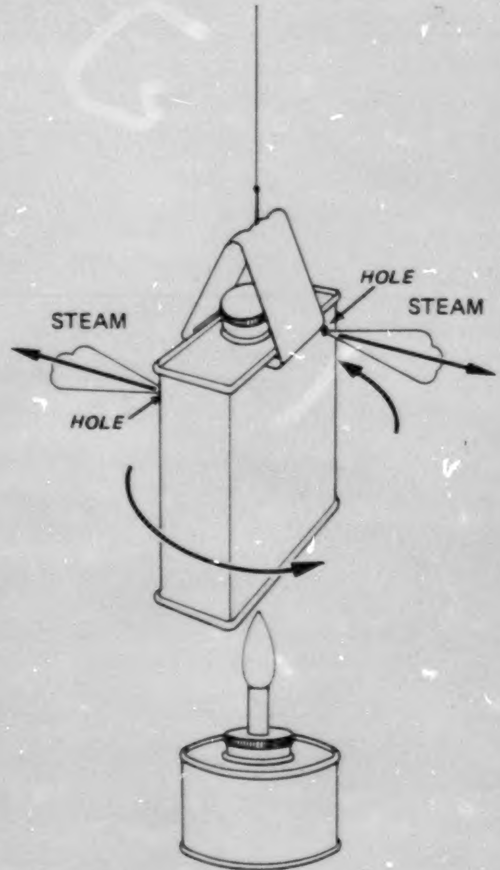
Substantive Topic (Suggested Level):

Energy Systems (Level 6)

Activity (Title and Description):

Constructing Hero's Engine (CIS, Brown)

This activity involves the building of Hero's Engine. The teacher will suspend a rectangular metal can containing water over a heat source. As the water boils, the children will observe steam coming from diagonally opposite corners. The children will be asked to compare the direction the can turns with the direction of the jets of steam.



Behavioral Performance Objectives:

The child will explain how the force of steam exerts push on a suspended object causing it to rotate.

The child will describe how Hero's Engine demonstrates Newton's Third Law of Motion which states that to every action there is an equal and opposite reaction.

The child will diagram the energy changes from chemical to heat to mechanical.

Alternate Activity (Title and Description):

Introductory Problems (ESS, Pendulums)

Children study swinging objects. They use bobs of different sizes, weights, and shapes. They vary the length of the string. They see that each change they make has an effect on the results. They learn about variables.

Behavioral Performance Objectives:

The child will manipulate a string and bob to observe what happens.

The child will identify that a pendulum has variables that result in different outcomes.

The child will use a graph or chart of the data collected by the class to interpret his findings.

Sources of Additional Activities for Substantive Topic: Energy Systems

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Models: Electric and Magnetic Interactions

ESS . . . . Kitchen Physics
ESS . . . . Batteries and Bulbs I and II

EIS . . . . Light
EIS . . . . Color

CIS . . . . Purple
CIS . . . . Brown

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- differentiate between reliable and less reliable sources of information and be unafraid to question these sources
- identify sets of conditions and recognize that these lead to specific inferences
- withhold judgments until they consider all available evidence
- recognize and acknowledge a job well done and be aware of feelings of personal satisfaction in their accomplishments and contributions
- recognize as logical the sequence in events such as cause and effect
- recognize the mechanics involved in problem solving

Content Area:

When matter changes from one form to another, the total amount of matter remains unchanged.

Substantive Topic (Suggested Level):

Matter and Energy in Nuclear Reactions (Level 6)

Activity (Title and Description):

Harvesting the Atom (CIS, Brown)

The children will conduct an investigation using water, ink, a jar, and a medicine dropper. They will experiment with the water and ink to observe movement and non-movement of particles of matter. They observe the action and record evidence of the action. Based on their observations, they will record evidence about cause and effect in the experiment.

Behavioral Performance Objectives:

The child will introduce drops of ink into a pail of still water and describe the interaction.

The child will record the results by using drawings showing the action of the molecules of the ink as it is dropped into the still water.

The child will construct a hypothesis that will explain the motion involved when the drops of ink mix with the still water.

Alternate Activity (Title and Description):

Air is Real (ESS, Gases and "Airs")

The children will perform an exploratory experiment using jars, candles, and a piece of cardboard. They will devise experiments with the objects trying to establish the presence of air. Each experiment should demonstrate that air is present. Recorded results will show evidence that points out the presence of air in the system.

Behavioral Performance Objectives:

The child will observe the movement of air by putting an empty jar over a lighted candle and recording the results.

The child will demonstrate the effect of each object upon the air in the jar by sketching a diagram of the results.

Sources of Additional Activities for Substantive Topic: Matter and Energy in Nuclear Reactions

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

SCIS . . . . Models - Electric and Magnetic Interactions

ESS . . . . Gases and "Airs"

ESS . . . . Senior Balancing

ESS . . . . Water Flow

MCPS . . . . Liquids

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- formulate their observations into statements of hypothesis
- acquire scientific information and concepts and organize them into meaningful generalizations
- increase their science vocabulary and relate this vocabulary to new situations
- recognize the mechanics involved in problem solving
- investigate by recognizing, collecting, and using data in solving problems

Content Area:

Living things are interdependent with one another and with their environment.

Substantive Topic (Suggested Level):

Adaptations of Living Things (Level 6)

Activity (Title and Description):

Growing Bacteria (CIS, Brown)

The children will perform an experiment in setting up an environment in which bacteria will grow and reproduce. They will prepare an unflavored gelatin and water mixture. They will also prepare unflavored gelatin mixed with a bouillon cube and warm water. They will observe the environment for changes and record these daily observations. They will compare the two samples and make inferences related to differences which have occurred. The children will prepare slides from the samples and make a drawing of things observed under the microscope.

Behavioral Performance Objectives:

The child will demonstrate the growth of bacteria on a food substance by comparing a controlled environment to an uncontrolled environment.

The child will describe cause and effect in the environments by developing a chart showing the contrast of the controlled and uncontrolled environment of an unflavored gelatin and bouillon mixture.

Alternate Activity (Title and Description):

Excess Food (SCIS, Ecosystems)

The children will prepare aquatic systems of snails and change one variable in each system. They will change the food-mineral cycle and the oxygen-carbon dioxide cycle and keep a detailed record of the changes between the systems. They will sketch their results to show the contents of each environment as any changes develop.

Behavioral Performance Objectives:

The child will describe the nature of interdependence of the aquatic systems through the use of terms such as decomposition, organic matter, pollutants, producers, and consumers.

The child will describe the behavior of animals in the aquatic system in relation to the pollutants added to the environment by generalizing the effect of variables, listing at least five effects.

Sources of Additional Activities for Substantive Topic: Adaptations of Living Things

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Behavior of Mealworms

ESS . . . . Crayfish

ESS . . . . Tracks

ESS . . . . Mosquitoes

ESS . . . . Mapping

MCPS . . . . Pond Study

MCPS . . . . School Grounds as a Site for Inquiry

EIS . . . . Life Processes of Plants

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- recognize that all human activities depend on the state of their physical being and their lives are determined by conditions in their physical and biological environments
- acquire scientific information and begin to make meaningful inferences useful in making generalizations
- withhold judgments until they consider all available evidence
- formulate their observations into statements of hypothesis

Content Area:

A living thing is the product of its heredity and environment.

Substantive Topic (Suggested Level):

Genetics and Characteristics (Level 6)

Activity (Title and Description):

Learning an Automatic Act (CIS, Brown)

In this activity the children will follow the steps outlined in the learning cycle to tie a bowline knot. The children will time themselves and continue practicing tying a bowline knot until the steps are automatic. They will keep a record of the number of times they attempted the steps involved in tying a bowline knot and the amount of time it takes to complete the processes.

Behavioral Performance Objectives:

The child will construct a graph showing the number of attempts and the time for each attempt required to tie a bowline knot.

The child will demonstrate his ability to formulate a hypothesis.

Alternate Activity (Title and Description):

Investigation Into a Human Reflex Act (CIS, Brown)

The children working in groups of two will test each other's knee reflex by tapping with the heel of the hand just below the knee. They will also try to control this reflex movement. The children will record observations of each trial.

Behavioral Performance Objectives:

The child will construct a chart of reflex acts.

Source of Additional Activities for Substantive Topic: Genetics and Characteristics

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following source. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

EIS . . . . Continuity of Life

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- demonstrate that science and technology are products of human endeavor and that in turn man is a product of his heredity and societal environment
- describe and evaluate the role of the scientific enterprise during the history of man
- recognize that men of science have made special contributions to the world at large through activities in research and study
- differentiate between reliable and less reliable sources for information and be unafraid to question these sources

Content Area:

Living things are in constant change.

Substantive Topic (Suggested Level):

Genetics and Change (Level 6)

Activity (Title and Description):

DNA: A Code (CIS, Brown)

The children will immerse the root system of an onion in water. They will observe the onion over several weeks and record daily what happens. The children will list the similarities and the differences between the parent plant and the young plant. The children will suggest reasons for the strong resemblances between parent and young plant.

Behavioral Performance Objective:

The child will describe through his daily observations how a plant may grow into a larger one exhibiting the same characteristics as the mature plants.

Alternate Activity (Title and Description):

An Investigation into the Effects of Environment on Living Things (CIS, Brown)

The children will study the effects of the environment on living things by cutting up a potato which has at least four buds. Each section of the potato will be planted in a clay pot. Variables such as food, water, and light will be changed daily for each potato except the fourth pot, which serves as the control pot. The children will record daily observations on a chart comparing the growth of each bud. They will state conclusions relating to the conditions which cause the best growth in these plants.

Behavioral Performance Objectives:

The child will demonstrate the effect of various conditions such as food, water, and light on plant growth in various environments.

Source of Additional Activities for Substantive Topic: Genetics and Change

To help you in planning and making decisions about content in relation to the remainder of your science program, the science teacher specialist should be contacted at the area administrative office.

FRAMEWORK FOR ELEMENTARY SCIENCE

Band: 5/6

Selected Outcomes:

Students should have experienced activities which enable them, within their individual capabilities, to:

- investigate by recognizing data collecting and using data in solving problems
- differentiate between reliable and less reliable sources for information and be unafraid to question these sources
- withhold judgments until they consider all available evidence
- recognize and acknowledge a job well done and be aware of feelings of personal satisfaction in their accomplishments and contributions

Content Area:

The universe is in constant change.

Substantive Topic (Suggested Level):

Radiant Energy of Stars (Level 6)

Activity (Title and Description):

Investigation into Sampling (CIS, Brown)

The children will perform activities using common household foodstuffs such as beans, peas, and macaroni to gain an understanding of large numbers and estimation. They will attempt to count the number of items in a pound by taking a spoonful of beans, counting them, recording the count, and putting them back. Repeat this five times. After they have completed the process, they will determine the average number of items in a spoonful. The children will then determine the number of spoonfuls per pound.

Behavioral Performance Objectives:

The child will demonstrate his ability to apply rough estimates in science by estimating the number of items per pound.

Alternate Activity (Title and Description):

An Investigation into Measuring Distant Objects (CIS, Brown)

The children will perform an activity to learn how to measure the size of a distant object. Using a 1" x 1" card, a lamp, and a ruler, they will measure the size of the lampshade. With the help of a classmate, they will record their observations, using the same unit of measure throughout the activity.

Behavioral Performance Objectives:

The child will perform the computations necessary to determine the size of the lamp shade using the figures from his observations.

The child will measure the size of the lamp shade, to verify his computations.

Sources of Additional Activities for Substantive Topic: Radiant Energy of Stars

To help you in planning and making decisions about content in relation to the remainder of your science program, materials for activities can be selected from the following sources. If assistance is needed, the science teacher specialist should be contacted at the area administrative office.

ESS . . . . Daytime Astronomy

EIS . . . . The Universe

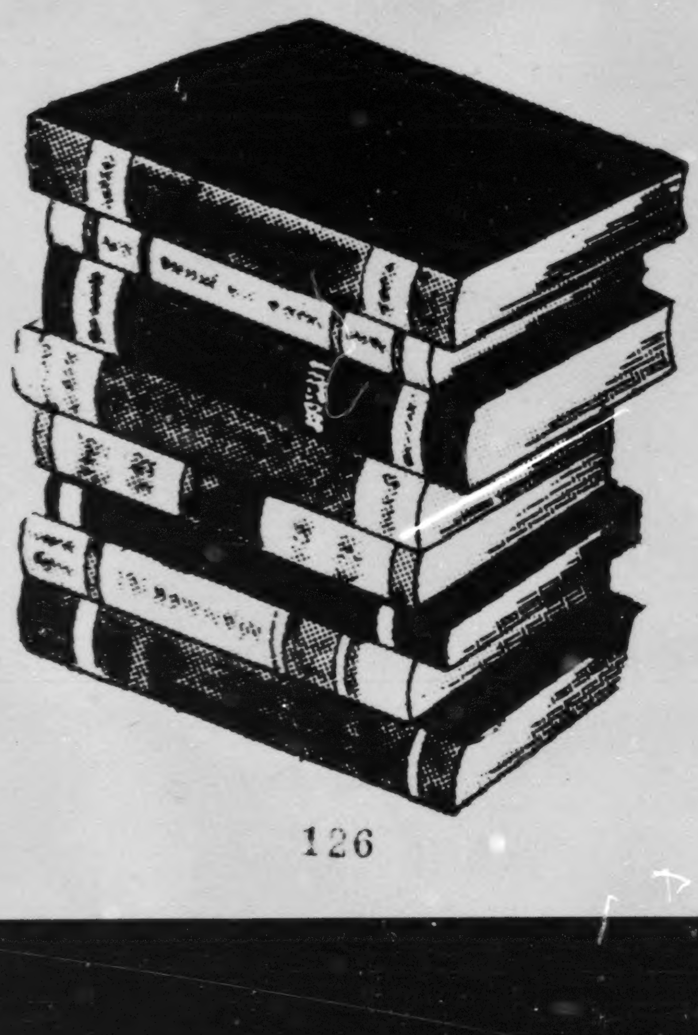
5

Appendix A

Approved Library Titles

Appendix B

The Area Specialist's Traveling Library



Appendix A

Elementary Science Book List
of
Approved Library Titles

Some of these annotations were excerpted from:
- AAAS Science Book List for Children
- NSTA Science Trade Books 1972
- NSTA Outstanding Science Trade Books for Children in 1973
- NSTA Science Books: A Quarterly Review

BAND: K/2

CONTENT AREA

When energy changes from one form to another, the total amount of energy remains unchanged.

Arch, Barbara. Let's Go to a Jetport. New York: G.P. Putnam's Sons, 1973.
The text begins with a takeoff exchange between pilot and tower and ends with another takeoff. In between, the reader takes a complete tour of the process of getting a plane, its cargo, its passengers, its crew, and even the airport ready for flight.

Bendick, Jeanne. Why Things Work. New York: Parents' Magazine Press, 1972.
An excellent book about energy with sprightly pictures that almost seem to move. Earth's energy starts with the sun; but light, heat, electricity, magnetism, sound, and wind are all forms of energy. Good questions make the reader a thinker.

Dodge, Bertha. Big is So Big. New York: Coward, McCann and Geoghegan, 1972.
Starts with the idea that "big" is relative. The concept of measurement progresses from the use of arbitrary devices to standardized measures. Excellent, simple pictures clarify the meaning of length, width, area, and volume.

Epstein, Sam and Beryl. Look in the Mirror. New York: Holiday House, Inc., 1973.
Flat and curved mirrors and mirror substitutes found around the house are the basis for simple experiments and observations. Appealing drawings by Tomie de Paola.

Feravolo, Rocco V. Junior Science Book of Electricity. Champaign, IL: Garrard Publishing Co., 1960.
A basic treatment of static and current electricity. Some of the topics covered are fuses, dry cells, short circuits, and electromagnets.

Hoban, Tana. Push, Pull, Empty, Full. New York: Macmillan Co., 1972.
Carefully chosen black and white photographs with only one word on each page clarify the idea of opposites as they face each other in the book. Even the youngest "reader" will understand and may be encouraged himself to develop additional antonyms.

Hutchins, Carleen Marley. Who Will Drown the Sound? New York: Coward, McCann and Geoghegan, 1972.
In this attractive picture book the nature, quality, and quantity of sound are explained in a chatty, naive, but pleasant manner.

Knight, David C. Let's Find Out About Magnets. New York: Franklin Watts, Inc., 1967.
History of early Greeks and their "lodestones." Explains the principles of magnets, their shapes and sizes, and some of the many uses of magnets in familiar things about the school and home.

Milgrom, Harry. Adventure with a Ball: First Science Experiments. New York: E.P. Dutton & Co., Inc., 1965.
Through simple experiments with a ball the child learns it is a sphere, and its behavior when bounced against different kinds of surfaces, when rolled on a flat surface, down an incline, the result of the impact of two balls striking one another, etc. Book finally invites the child to try additional experiments.

---. First Experiments with Gravity. New York: E.P. Dutton & Co., Inc., 1966. Simple and easy to procure materials are used in twenty experiments that illustrate the principles and forces of gravity.

Pine, Tillie S., and Levine, Joseph. Gravity All Around. New York: McGraw-Hill Book Co., 1963.
Simple experiments included which bring gravity out of the world of vague concepts and into the everyday environment of the children.

Reuben, Gabriel H., and Archer, Gloria. What is a Magnet. Westchester, IL: Benefic Press, 1959.
A basic comprehensive discussion of magnets and their uses which defines as well as describes. Explains atomic structure of magnets.

Simon, Seymour. Hot and Cold. New York: McGraw-Hill Book Co., 1972.
Simple projects arouse an awareness of different temperatures under varying circumstances. Includes the function of a thermometer, sources of heat, heat transfer, convection, and insulation. Charming illustrations.

CONTENT AREA

When matter changes from one form to another, the total amount of matter remains unchanged.

Bloome, Enid. The Air We Breathe. New York: Doubleday & Co., Inc., 1971.
A picture book depicting the pollution of the air we breathe, how it is being polluted, as well as telling ways people can help to clean the air.

---. The Water We Drink. New York: Doubleday & Co., Inc., 1971.
The author introduces young readers to the problems of water pollution, stressing the importance of water to the life of man, other animals, plants; describes the numerous things that each day add to the ever-increasing pollution of water.

Busch, Phyllis S. A Walk in the Snow. Philadelphia: J.B. Lippincott Co., 1971.
A book that answers the questions that children have concerning snow. Also included are some simple experiments that a child can do.

Cartwright, Sally. Water is Wet. New York: Coward, McCann and Geoghegan, 1973.
A delightful way to introduce water in its many forms through simple activities which are easy and safe for young children. The illustrations by Marilyn Hafner are attractive and informative, and complement the easy-to-read text.

Kalina, Sigmund. Air, the Invisible Ocean. New York: Lothrop, Lee and Shepard Co., Inc., 1973.
What air is, how living things use and renew it, and why we must free it from pollution are carefully described in this delightful book. The illustrations by Kazue Mizumura add to the basic concepts being explored.

Lefkowitz, R.J. Water for Today and Tomorrow. New York: Parents' Magazine Press, 1973.
This book introduces the young child to water and its uses (drinking, cleaning, recreation) and properties (no color, smell, taste, or shape). The three states of water are discussed and terms are defined.

Munch, Theodore W. What is Heat. Westchester, IL: Benefic Press, 1960.
Studying natural as well as artificial sources of heat, ways of measuring heat and its motion. Heat is important to man.

Wiesenthal, Eleanor and Ted. Let's Find Out About Rivers. New York: Franklin Watts, Inc., 1971.
A book that tells the value of rivers in the environment, viz., providing homes for animals, serving many needs of people as a place to work, a means of transportation, a place of recreation, and also helping to make electricity.

Wyler, Rose, and Ames, Gerald. Secrets in Stones. New York: School Book Service, 1971.
A book which describes things to know about rocks, such as how they are made; where they come from; what crystals are; and how to identify feldspar, mica, and quartz.

CONTENT AREA

Living things are interdependent with one another and with their environment.

Buxton, Ralph. Nature's Pincushion, the Porcupine. Chicago: Childrens Press, 1972.
This straightforward, readable tale describes the porcupine's physical characteristics, lifestyle, self-defense, food, breeding habits, and location. Delightful illustrations in green and brown catch the uniqueness of the animal.

Conklin, Gladys. We Like Bugs. New York: Holiday House, Inc., 1962.
Simple observation of some common insects through the eyes of a child.

---. When Insects are Babies. New York: Holiday House, Inc., 1969.
A look into the life and habits of some of the most common insects. Insect habitats, growth patterns, and appearance are described.

---. Tarantula: The Giant Spider. New York: Holiday House, Inc., 1972.
A calm, keen study of the fearsome-looking tarantula: a gentle creature in regard to man, but a dangerous threat to many harmful insects.

Freschet, Berniece. The Web in the Grass. New York: Charles Scribner's Sons, 1972.
Bold illustrations and simple text combine vividly to relate the tale of a small spider in this superior science book.

Frith, Michael. *Some of Us Walk...Some Fly...Some Swim*. New York: Random House, Inc., 1971.
Details of an insect's way of life are revealed as you learn about its ways of making a home, protecting itself, as well as its way of moving about in its habitat.

Graham, Margaret Bloy. *Be Nice to Spiders*. Eau Claire, WI: E.M. Hale & Co., 1972.
The value of a spider is seen as a spider consumes insects in a zoo. Develops an appreciation for spiders in the chain of life.

Hiss, Anthony. *The Giant Panda Book*. Racine, WI: The Western Publishing Co., Inc., 1973.
A most interesting and attractive children's book on the popular giant panda. The color illustrations by Greg and Tim Hildebrandt are excellent and appropriately illustrate the story in the text.

Poulet, Virginia. *Blue Bug's Vegetable Garden*. Chicago: Childrens Press, 1973.
An attractive cover lures the reader into this book - the illustrations are colorful and extremely appealing. This book offers the beginning reader the opportunity to learn concepts such as above, below, beside, over, up, down, and through. The child will also enlarge his vocabulary about vegetables which grow above and below the ground.

Rosen, Ellsworth. *Spiders are Spinners*. Boston: Houghton-Mifflin Co., 1968.
The structure and function of the spider and the use of its web.

Selsam, Millicent, and Hunt, Joyce. *A First Look at Leaves*. New York: Walker & Co., 1972.
A brief, well-organized book on characteristics and kinds of leaves. Illustrations are clear and generally accurate. Encourages a child's interest and observation. Using printer's ink for leaf prints may require adult help. A series.

Selsam, Millicent. *Is This a Baby Dinosaur?* New York: Harper and Row Publishers, 1972.
This is a beautifully illustrated book which encourages children to use their imaginations to solve the questions in the book and to find pictures of their own. Facts are learned through fun.

Showers, Paul. *Your Skin and Mine*. New York: Thomas Y. Crowell Co., 1965.
Helping one to understand the skin and its function as well as the hair and the fingernails.

Silverstein, Alvin and Virginia. *Rabbits: All About Them*. New York: Lothrop, Lee and Shepard Co., Inc., 1973.
This clearly written book is highly recommended for young readers. It has many facts about rabbits such as how they live in the wild, how to care for them as pets, and the value of rabbits as research animals. There are also a few rabbit stories.

Steiner, Barbara. Biography of a Polar Bear. New York: G.P. Putnam's Sons, 1972. A delightful story about a young polar bear named Nanook, how the mother bear takes care of her young during the winter, how Nanook learns to catch food, and survive as a polar bear. The beautiful illustrations make the book more entertaining and interesting.

Sullivan, George. Plants to Grow Indoors. Chicago: Follett Pub. Co., 1969. Growing plants by using inexpensive materials and materials which are easily available to you.

Watson, Aldren A. A Maple Tree Begins. New York: Viking Press, Inc., 1970. Description of the maple tree from the seeds, germinations, growth of the trees (annual rings), and the flower and seed dispersal.

CONTENT AREA

A living thing is the product of its heredity and environment.

Blough, Glenn O. Who Lives in This House? New York: McGraw-Hill Book Co., 1957. Describes the many different kinds of animals living in an empty house and how they are dependent on each other.

Brenner, Barbara. Bodies. New York: E.P. Dutton & Co., Inc., 1973. A lovely, short picture book introducing the body. The materials are appropriate for preschool and elementary age children.

---. If You Were An Ant. New York: Harper and Row Publishers, 1973. Pretending is a great pastime for children, and If You Were An Ant provides an excellent opportunity for fantasy based on accurately and concisely presented facts.

Cooper, Kay. A Chipmunk's Inside-Outside World. New York: Julian Messner, 1973. How the chipmunk adapts to his two environments, inside the burrow and in the outside world. The photographs by Alvin Staffen enhance this interesting story.

Hammond, Winifred G. The Riddle of Seeds. New York: Coward, McCann and Geoghegan, 1966. A question and answer approach to the plant physiology, the size of seeds in relation to the size of the plants that grow from them.

Litwin, Wallace. Ostrich. New York: Coward, McCann and Geoghegan, 1973. A delightful story of the life cycle of the ostrich. The photographs by Wallace Litwin are excellent. Among the most dramatic is a step-by-step sequence of a baby ostrich breaking out of the tough skin and shell of a large egg and giving his "call of triumph."

McClung, R.M. Blaze: The Story of a Striped Skunk. New York: William Morrow and Co., Inc., 1969. Follow a striped skunk, Blaze, through one year of her life. The story tells about living and eating habits, natural enemies, and the bearing of young and their nurture and training.

Pringle, Laurence. Twist, Wiggle and Squirm: A Book About Earthworms. New York: Thomas Y. Crowell Co., 1973.
An excellent book about earthworms. Treats the many facets of the life of an earthworm in a language that primary school youngsters would understand.

Schwartz, Elizabeth and Charles. When Flying Animals are Babies. New York: Holiday House, Inc., 1973.
Animals that are familiar to many children, such as the pheasant, chicken, monarch butterfly, quail (esp. bobwhite), robin, and barn swallow. Teaches the ways in which they are alike and different, how parents care for them, how fast they grow, and what they eat. Careful detailed illustrations.

Selsam, Millicent. How Puppies Grow. New York: Four Winds Press, 1972.
Accurate information, written simply for the beginning reader. This book would appeal to most children. The photographs are well done showing puppy's growth from birth to eight weeks.

Silverstein, Alvin and Virginia. Rabbits: All About Them. New York: Lothrop, Lee and Shepard Co., Inc., 1973.
This clearly written book is highly recommended for young readers. It has many facts about rabbits, such as how they live in the wild, how to care for them as pets, and the value of rabbits as research animals. There are also a few rabbit stories.

CONTENT AREAS

Living things are in constant change.

Aliki. Fossils Tell of Long Ago. New York: Thomas Y. Crowell Co., 1971.
Fossil marine plants and animals, dinosaurs, ferns, mammoths, insects, and trees. How natural fossils are formed and directions for making a minute-old "fossil." Meaningful, fun text and pictures.

Armour, Richard. A Dozen Dinosaurs. New York: McGraw-Hill Book Co., 1967.
Description of twelve different dinosaurs and their life while living on earth.

Posin, Daniel Q. What is a Dinosaur. Westchester, IL: Benefic Press, 1961.
An elementary comprehensive discussion which shows why dinosaurs are reptiles, excellently describes their physical characteristics, and distinguishes between the two principal groups of dinosaurs.

Selsam, Millicent E. Benny's Animals: and How He Put Them in Order. New York: Harper and Row Publishers, 1966.
This story explains the differences between living and nonliving entities, between plants and animals, and between man and other animals. An introduction to the primary skills of classifying animals.

Selsam, Millicent E., and Hunt, Joyce. A First Look at Mammals. New York: Walker & Co., n.d.
Mammals are classified according to such characteristics as flippers, hooves, and different kinds of teeth. The illustrations by Harriett Springer on each page help children to see these characteristics. Young people will understand the simple language. To reinforce the learning process, puzzles and matching games are included.

CONTENT AREA

The universe is in constant change.

Asimov, Isaac. Galaxies. Chicago: Follett Pub. Co., 1968.
An introduction to the galaxy Milky Way, its planets and some of its principal constellations, with suggestions on how to find the Milky Way galaxy, and the Andromeda galaxy.

Branley, Franklyn M. Eclipse: Darkness in Daytime. New York: Thomas Y. Crowell Co., 1973.
This unusually beautifully illustrated book is written for primary children, but some older children would find the book fun to look at and read for information concerning solar eclipses.

---. Flash, Crash, Rumble and Roll. New York: Thomas Y. Crowell Co., 1964.
A study into the facts concerning lightning as to its formation and how it precedes the rumble of thunder. The dangers of lightning and some of its myths are part of this book.

Friskey, Margaret. The True Book of Air Around Us. Chicago: Childrens Press, 1953.
The atmosphere - its composition, weather, and importance to man. Everyday observance such as wind, storms, clouds, lightning and thunder, and various forms of precipitation.

Knight, David C. Let's Find Out About Weather. New York: Franklin Watts, Inc., 1967.
An understanding of the weather phenomena is presented as well as help in making one's own weather prediction.

Larrick, Nancy. Rain, Hail, Sleet, and Snow. Champaign, IL: Garrard Publishing Co., 1961.
Explains these kinds of precipitation, including their causes and effects.

Pine, Tillie S., and Levine, Joseph. Weather All Around. New York: McGraw-Hill Book Co., 1966.
This book encourages children to think and ask questions about their environment and to seek answers.

Rosenfeld, Sam. A Drop of Water. Irvington-on-Hudson, NY: Harvey House, Inc., Publishers, 1970.
The study of what happens to a drop of water provides an introduction to meteorology, evaporation, condensation, the formation of clouds, rainfall, and other facts involving the importance of water and dependence of life on it.

Simon, Seymour. Let's Try it Out - Light and Dark. New York: McGraw-Hill Book Co., 1970.
A first in the introduction to light and optics. A discussion on the properties of light and darkness.

Syrocki, B. John. What is Weather? Westchester, IL: Benefic Press, 1960.
Explains many aspects of the atmosphere and its disturbance; evaporation and condensation, dew point, clouds, relative humidity, wind and convection currents, weather instruments and prediction, pressure, fronts, and storms.

CONTENT AREA

When energy changes from one form to another, the total amount of energy remains unchanged.

Adler, Irving and Ruth. Magnets. New York: John Day Co., Inc., 1966.
A look into why magnets react as they do, and a study about the atoms and molecules that make up magnetic materials.

Anderson, Dorothy S. Junior Science Book of Sound. Champaign, IL: Garrard Publishing Co., 1962.
An introduction to sound - how it is produced, transmitted, and heard. A study into the sounds produced by man, animals, and musical instruments.

Balestrino, Philip. Hot as an Ice Cube. New York: Thomas Y. Crowell Co., 1971.
Children learn that sensations are comparative and that heat flows from something warm to something cold. Easy experiments are included for the interested child.

Branley, Franklyn M. High Sound, Low Sounds. New York: Thomas Y. Crowell Co., 1967.
The child is led to learn more about sound through activities found in this book. Explanations are also given to help the child understand his involvement in sound.

Scott, John M. What is Sound? New York: Parents' Magazine Press, 1973.
For advanced elementary school children. The many ways in which sound affects us are stressed, and children are directed to many demonstrations and experiments that they can easily reproduce with materials available in nearly every home and classroom.

Urquhart, David. Plumbing and How it Works. New York: Henry Z. Walck, Inc., 1973.
How our plumbing system works with faucets, traps, flush tanks, and cesspools and their history.

---. The Refrigerator and How it Works. New York: Henry Z. Walck, Inc., 1972.
The science and technology of one of our most useful appliances. Helpfully illustrated, concise, and interesting. A companion to the author's Central Heating and How it Works.

CONTENT AREA

When matter changes from one form to another, the total amount of matter remains unchanged.

Adler, Irving. Atomic Energy. New York: John Day Co., Inc., 1971.
A clear and accurate account of fossil fuels which leads into a discussion of atomic structure. The nucleus, isotopes, nuclear stability, and atomic energy.

Bartlett, Margaret Farrington. Where Does All the Rain Go? New York: Coward, McCann and Geoghegan, 1973.
An account of where the rain goes, what it does, and how it comes again. Describes the water cycle in terms of its relationship to the earth and living things. Good illustrations by Patricia Collins.

Carona, Philip B. The True Book of Chemistry: What Things are Made of. Chicago: Childrens Press, 1962.
An explanation of chemical elements and their symbols, atoms and molecules, state of matter, compounds, formulas, and chemical versus physical changes.

Freeman, Mae and Ira. The Story of the Atom. New York: Random House, Inc., 1960.
A simple explanation of molecular and atomic structure, natural and synthetic "splitting" of atoms, and modern nuclear research and progress.

Gallob, Edward. City Rocks, City Blocks and the Moon. New York: Charles Scribner's Sons, 1973.
The intent of this book is to encourage city children to observe and collect rocks that are found in the city. The descriptions of the three categories of rocks - igneous, sedimentary, and metamorphic - should be understandable to any child with a reasonably wide vocabulary although words like quartz and texture are used.

Gans, Roma. Millions and Millions of Crystals. New York: Thomas Y. Crowell, 1973.
This book makes an unknown subject meaningful for even the youngest reader or listener. Gans describes many different types of crystals: salt, sugar, diamonds, rock. The mechanism of crystal formation is discussed. Atoms are explained in the simplest terms so that a child can understand how and why.

Russell, Helen Ross. Water, A Field Trip Guide. Boston: Little, Brown and Co., 1973.
The theme is water and its importance. Illustrated by photographs that are both functional and beautiful.

CONTENT AREA

Living things are interdependent with one another and with their environment.

Busch, Phyllis S. Dining on a Sunbeam: Food Chains and Food Webs. New York: Four Winds Press, 1973.
That sunlight is the source of everything we eat is the central theme developed in terms and situations to which young children can relate. Food chains and webs are similarly developed. Les Lines' photographs are superb but are not identified as to content and subject, which may frustrate the curious reader.

---. Exploring as You Walk in the City. Philadelphia: J.B. Lippincott Co., 1972.
Coordinated photographs and text challenge the children to explore the streets of a city underfoot, overhead, and in between, and to make observations. Exciting follow-up activities are suggested. A separate leader's guide with information and provocative questions is supplied.

Darling, Lois and Louis. Worms. New York: William Morrow and Co., Inc., 1972.
Collecting, keeping, and studying some of the most common animals in the environment. Describes the behavior and structure and emphasizes the interdependence of living things. Helpfully and artistically illustrated.

Earle, Olive L. Scavengers. New York: William Morrow and Co., and Inc., 1973.
Describes the appearance and behavior of insects, mammals, and birds that perform a valuable function in nature. Material not easily found elsewhere about an important aspect of ecology.

Epple, Anne Orth. The Lookalikes. New York: St. Martin's Press, Inc., 1971.
This is a book for the child who has difficulty with the animals that look alike. Included in the book are twenty-nine pairs of look-a-likes.

Gallob, Edward. City Leaves, City Trees. New York: Charles Scribner's Sons, 1972.
This volume is artistic as well as scientific, so beautiful are the photographs and photograms of many common deciduous and evergreen trees and their structures found in the cities of eastern and central United States and Canada.

Graves, Charles P. John Muir. New York: Thomas Y. Crowell Co., 1973.
An introductory account of Muir's life centering on his contributions as a naturalist and ecologist. His knowledge of the American wilderness and his influence on the establishment of national parks are highlighted.

Hawes, Judy. What I Like About Toads. New York: Thomas Y. Crowell Co., 1969.
A child explains why toads are friends of farmers, and then describes the growth of young toads from eggs to adults, their eating habits, hibernation, and ingenious defenses against danger.

Hiser, Iona. The Gila Monster. Austin: Steck-Vaughn Co., 1972.
An intriguing review and description of the strange gila monster with pictures that will fascinate children of primary as well as intermediate grades. Illustrations of other members of the lizard family are also included.

Limburg, Peter R. Watch Out, It's Poison Ivy! New York: Julian Messner, 1973.
All one wants to know about poison ivy - what the plant looks like, where it grows, and how to avoid it. Symptoms, treatment, and immunization are discussed. Photos and glossary are an added help.

May, Julian. Islands of the Tiny Deer. Reading, MA: Addison-Wesley Publishing Co., Inc., 1972.
Describes the life cycle of the deer on the Florida Keys. Adaptation to the environment led to their small size. Explains how they were saved from extinction. The beautiful illustrations include other animals found in the area.

Polseno, Jo. Secrets of Redding Glen: The Natural History of a Wooded Valley. Racine, WI: Western Publishing Co., Inc., 1973.
Somewhere in our northern wildernesses are there still unspoiled places like Redding Glen? It must be the purpose of a mood book like this to teach children to respect the complexities of untouched natural life and the infinity of interrelationships in it. The message is handled well with simple clear illustrations and direct text.

Pringle, Laurence. Into the Woods: Exploring the Forest Ecosystem. New York: Macmillan Co., 1973.
An appreciation for a forest and how it helps men is brought out in this book. The glossary is a useful addition.

Roever, J.M. The Black-footed Ferret. Austin: Steck-Vaughn Co., 1972.
This clearly written, well-organized little book contains a remarkable amount of information about its subject, including its history in relation to man. Valuable are a range map, a diagram of a "Prairie Food Chain," and many drawings useful for identification.

Selsam, Millicent. Vegetables From Stems and Leaves. New York: William Morrow and Co., Inc., 1972.
Excellent photographs depict the stages of growth in asparagus, cabbage, celery, lettuce, spinach, and other vegetables whose stems and leaves we eat. The superb photographs complement the text and clarify it.

Shanks, Ann Zane. About Garbage and Stuff. New York: Viking Press, Inc., 1973.
Unpaged. Printed on recycled paper, this photographic "essay" is a fine exposition of problems of disposal and recycling of waste.

Shuttlesworth, Dorothy E. Clean Air - Sparkling Water: The Fight Against Pollution. New York: Doubleday & Co., Inc., 1968.
How to fight pollution of our two most important needs. How have conditions resulted in such pollution? What can be done about it? Specific examples and excellent, appropriate photographs answer these questions and other related ones.

Silverstein, Alvin and Virginia. The Long Voyage: The Life Cycle of a Green Turtle. New York: Frederick Warne & Co., Inc., 1972.
The wandering life of a turtle, from hatching through egg production, is described through the eyes of "the boy" whose father attaches radio transmitters to baby turtles. Somewhat anthropomorphic in style but informative. Colorful, impressionistic illustrations.

Silverstein, Alvin and Virginia. Mammals of the Sea. Los Angeles: Golden Gate, 1971.
A study into the needs for the conservation and protection of sea mammals. Stories of some of the happenings of some of these animals are included.

Simon, Hilda. Dragonflies. New York: Viking Press, Inc., 1972.
An accurate, descriptive, and even poetic story of the life cycle of dragonflies. The drawings by the author enhance the story. Maps show the distribution of various species in the United States.

Simon, Seymour. A Building on Your Street and a Tree on Your Street. New York: Holiday House, Inc., 1973.
Especially appropriate for helping urban children explore and discover significant facts about their immediate surroundings. Varied suggestions and stimulating drawings by Leonard Shortall are designed to inspire children to use the basic skills of science as they study their environment.

Stephens, William. Come With Me to the Edge of the Sea. New York: Julian Messner, 1972.
Through words and photographs, the author challenges the reader to observe carefully at the beach; birds, fish, sand, plants, shells, and the water. Many suggestions encourage the reader to reach conclusions after making careful observations.

Tresselt, Alvin. The Dead Tree. New York: Parents' Magazine Press, 1972.
A sensitive story of the life cycle of a tree. It slowly dies and disintegrates into rich soil with the help of many animals and insects. New seedlings take root and grow as nature renews itself. Beautiful paintings that illustrate the text can be "read" and understood by the youngest of children.

CONTENT AREA

A living thing is the product of its heredity and environment.

Barkalow, Frederick S., Jr., and Shorten, Monica. The World of the Gray Squirrel. Philadelphia: J.B. Lippincott Co., 1973.
Early sections of the book describe the many kinds of squirrels, including the American red squirrel, the fox squirrel, and chipmunk. Likenesses and differences of these different species and other subspecies are compared. Then attention is centered on the gray squirrel.

Buck, Margaret. How They Grow. Nashville: Abingdon Press, 1972.
Young zoologists will enjoy the excellent illustrations that accompany each descriptive passage relating the growth and development of seventeen species of small animals inhabiting a pond environment. Included are insects, amphibians, fish, reptiles, birds, and mammals.

Busch, Phyllis S. Exploring as you Walk in the Meadow. Philadelphia: J.B. Lippincott Co., 1972.
Text and photographs explore the animals, insects, birds, and plants observed by some children on a walk in a meadow.

Cole, Joanna. My Puppy is Born. New York: William Morrow and Co., Inc., 1973.
Simple and appealing photographs in black and white by Jerome Wexler demonstrate explicitly and with dignity eight weeks in the life of a miniature dachshund.

Cole, Joanna, and Edmondson, Madelaine. Twins: The Story of Multiple Births. New York: William Morrow and Co., Inc., 1972.
The authors describe the pre- and postnatal development of twins and the difference between identical twins and fraternal twins. Case studies of sets of twins separated and reared apart from one another add considerable interest.

Conklin, Gladys. The Lion Family. New York: Holiday House, Inc., 1973.
A young lioness exemplifies how these beautiful cats continue to survive on the Serengeti Plains of East Africa. Soft drawings by Joseph Cellini enhance the text.

Fenner, Carol. Gorilla Gorilla. New York: Random House, Inc., 1973.
This magnificent book will surely become a treasured possession of many young readers. The text scientifically and accurately tells the story of a baby gorilla who reaches maturity in his native land and is then captured and sent to a zoo.

Gross, Ruth Belov. A Book About Pandas. New York: Dial Press, Inc., 1973.
Simple, direct narration on what pandas are, what they eat, and how they live - both in the wild and in captivity. Amply illustrated with photographs, including America's pair, Ling Ling and Hsing Hsing.

Huntington, Harriet E. Let's Look at Reptiles. New York: Doubleday & Co., Inc., 1973.
Plentifully illustrated with marvelous photos, this is a model of clarity and organization. Even without an index, it should prove useful for elementary school reference.

Hutchins, Ross. The Carpenter Bee. Reading, MA: Addison-Wesley Publishing Co., Inc., 1972.
Everything you want to know about the habits and life cycle of a fascinating insect. A story line, describing the observations of a small boy as the seasons pass adds interest, and the excellent art work provides help in understanding.

---. Paper Hornets. Reading, MA: Addison-Wesley Publishing Co., Inc., 1973.
The ever-repeating life cycle of the paper hornet centering around the building and maintaining of the paper nest. Describes how the nest is built and how young hornets are reared and protected.

McCoy, J.J. Our Captive Animals. New York: Seabury Press, Inc., 1972.
These true stories of captive animals, illustrated with photographs, will appeal to children who listen to the stories as well as those able to read them. The problems of keeping the animals safe and healthy, and of breeding them, are among the subjects included.

McNamara, Louise, and Litchfield, Ada Bassett. Your Living Bones. Boston: Little, Brown and Co., 1973.
Characteristics and uses of the bones that compose the skeleton. Interestingly illustrated by Ruth Hartshorn.

McNulty, Faith. Prairie Dog Summer. New York: Coward, McCann and Geoghegan, 1972.
A young boy, Paul, helps a zoologist working on a field study about prairie dogs. His attitude changes from that of a hunter to a protector of all species. An exciting story in large print, with simple illustrations.

Naylor, Penelope. The Spider World. New York: Franklin Watts, Inc., 1973.
The African tale of "Anansi the Spider" is used to introduce the readers to the life of the spiders. To introduce the chapter on courtship and reproduction, Anansi appears again. The anatomy of spiders and their place in the animal kingdom are described.

Pringle, Laurence. Follow A Fisher. New York: Thomas Y. Crowell Co., 1973.
This excellent nature book contains an account of a member of the weasel family, resident in the wild northern forests. The author leads the reader along the trail of the fisher, and the story of its habitat, diet, and life cycle naturally unfolds from the evidence of the trail.

Pye, David. Bats. New York: McGraw-Hill Book Co., 1970.
An introduction to the bats; their anatomical modification that enables them to fly; their growth, feeding habits, diversity of species, and hibernation; and their keen accoustical senses.

Vevers, Gwynne. Birds and Their Nests. New York: McGraw-Hill Book Co., 1973.
Both common and unusual birds - in trees, on the ground, on water - are well described. Excellent illustrations by Colin Threadgall.

Waters, John F. Green Turtle Mysteries. New York: Thomas Y. Crowell Co., 1972.
The vocabulary is simple and the illustrations very good. This is a delightful book that describes the instinctual behavior of the turtles and then presents the "why" as the mystery. Mysteries are described in a way that challenges the young mind.

Wise, William. The Strange World of Sea Mammals. New York: G.P. Putnam's Sons, 1973.
A most commendable presentation of facts for the young reader concerning vanished, vanishing, and flourishing sea mammals. The origin of sea mammals, the life cycle, environment, and chance of survival against man and fellow creatures are well-described.

CONTENT AREA

Living things are in constant change.

Bendick, Jeanne. Why Things Change. New York: Parents' Magazine Press, 1973.
Words like evolve, adapt, survive, and extinct take on genuine meaning. A developing time chart lends cohesion to this excellent book. Packed with information and helpful drawings.

Bentley, William. The Alligator Book: Sixty Questions and Answers. New York: Walker & Co., n.d.
Using simple questions and answers, the author teaches us all there is to know about alligators - their origin, habits, how and where they live, and why we want to keep alligators in the world.

Berry, James. Why You Feel Hot, Why You Feel Cold: Your Body's Temperature. Boston: Little, Brown and Co., 1973.
Explains why you feel hot and cold and why you may have a fever and chills, along with experiments that help explain the ideas. Large type. Helpful illustrations by William Ogden.

Jacobs, Francine. Sea Turtles. New York: William Morrow and Co., Inc., 1972.
Danger of extinction threatens sea turtles. The author explains their plight and zeroes in on operations striving to assure their survival. Exciting and hopeful.

May, Julian. Why the Earth Quakes. New York: Holiday House, Inc., 1969.
A book which answers the child's questions about what causes earthquakes, volcanoes, and the movement of continents.

Rahn, Joan. Seeing What Plants Do. New York: Atheneum Publishers, 1973.
The importance of plants, their needs, their structure, and how they grow. Twenty-one interesting experiences and experiments are described with explanations given at the end of the book.

Tresselt, Alvin. The Beaver Pond. New York: Lothrop, Lee and Shepard Co., Inc., 1970.
A story of the work and habitat of a beaver and its influence on the ecological environment.

Zappler, Lisbeth. The Natural History of the Tail. New York: Doubleday & Co., Inc., 1972.
Tails of marine and land animals are carefully considered in this unusual, eye-opening account. Off-beat, informative, scientific, and gently humorous.

CONTENT AREA

The universe is in constant change.

Asimov, Isaac. The Moon. Chicago: Follett Pub. Co., 1966.
A description of the physical features of the moon, its atmosphere, gravity, and surface. An explanation on how it appears and affects the earth through tides and eclipses.

Branley, Franklyn M. A Book of Flying Saucers for You. New York: Thomas Y. Crowell Co., 1973.
Interesting, informed, and sober coverage of flying saucers is needed for younger readers, and this author provides it. In his usual readable and enjoyable prose, he offers a good selection of bizarre sightings, reveals a few hoaxes, and explains what most "saucer" sightings turn out to be.

Branley, Franklyn M. *Gravity is a Mystery*. New York: Thomas Y. Crowell Co., 1970.
The force of gravity is explained and the gravitational forces on the sun, on the earth, and on other planets are carefully explained.

---. *The Nine Planets*. New York: Thomas Y. Crowell Co., 1971.
A description of the nine planets of our solar system with current information collected from space vehicles. The book is indexed and has a list of references.

Brindze, Ruth. *Hurricanes: Monster Storms from the Sea*. New York: Atheneum Publishers, 1973.
Beginning with a dramatic and accurate description of the 1969 storm "Camille," Brindze provides both current and historical information on hurricanes. The use of satellite pictures is an important feature of this and later chapters.

Gallant, Roy A. *Exploring the Moon*. New York: Doubleday & Co., Inc., 1966.
A collection of data and information on the moon as developed through astronomic research. A chronology of events and discoveries related to the moon and to the earth is included in this book.

---. *Exploring the Sun*. New York: Doubleday & Co., Inc., 1958.
An account of the evolution of man's ideas about the sun from his earliest superstitions to his modern theories. A discussion of the course and effect of sunspots, prominences, and flares are among topics covered.

Milgrom, Harry. *First Experiments with Gravity: Exploring the Force of Gravity and Its Effects with 20 Basic Experiments*. New York: E.P. Dutton Co., Inc., 1966.
The author presents twenty basic experiments with step-by-step directions, showing the effect of gravity on time, weight, and motion.

Moore, Patrick, and Hardy, David. *Challenge of the Stars*. Chicago: Rand-McNally & Co., 1972.
Gives a vivid account of man's progress into space, from the first artificial satellite to the present. The book also tells about the development of massive orbital space stations which will be used as starting bases for interplanetary flights.

Pine, Tillie S., and Levine, Joseph. *Gravity All Around*. New York: McGraw-Hill Book Co., 1963.
This book discusses what gravity is, how it keeps the planets in orbit, how it helps man, and how space ships escape its force.

Weiss, Malcolm E. *Storms From the Inside Out*. New York: Julian Messner, 1973.
Weiss has written an excellent juvenile book on hurricanes, tornadoes, cyclones, thunder, lightning, and clouds. The illustrations and photographs are well conceived and executed, and the word descriptions of the formation of the weather processes tie in well with the pictures.

CONTENT AREA

When energy changes from one form to another, the total amount of energy remains unchanged.

Asimov, Isaac. More Words of Science. Boston: Houghton Mifflin Co., 1972.
In this sequel to Words of Science (1959), Isaac Asimov has brought his dictionary of scientific terminology up-to-date in a lively volume in which two hundred and fifty entries are lucidly defined in one-page essays.

Berger, Melvin. Computers. New York: Coward, McCann and Geoghegan, 1972.
Simple, well-illustrated description of computer technology. The account includes the uses as well as the mechanics of computers.

Branley, Franklyn M. Gravity is a Mystery. New York: Thomas Y. Crowell Co., 1970.
The force of gravity is explained and the gravitational forces on the sun, on the earth, and on other planets are carefully explained.

Budlong, Ware T. Performing Plants. New York: Simon and Schuster, Inc., 1969.
This book introduces topics such as tropisms, partnerships, responses to electricity and sound, seed dispersal, bioluminescence, and others.

Cobb, Vicki. Heat. New York: Franklin Watts, Inc., 1973.
"Heat" is hard to define in terms simple enough for a young child to understand, and although this is a "first" book, it is for children in the fourth grade and higher. From the imaginative cover onwards, this book will capture the children's interest.

Engle, Eloise. Parachutes: How They Work. New York: G.P. Putnam's Sons, 1972.
The author deftly combines the history and evolution of these aircraft in stimulating style. Included is specific information about parachutists from World War I on. Glossary and index add to book's usefulness.

Harman, Carter. A Skyscraper Goes Up. New York: Random House, Inc., 1973.
Erecting the Exxon Building in New York City is the subject of this book; written in lively prose and amplified by clear photos and diagrams. One learns how many kinds of people, skills, and machines are used in constructing and maintaining a huge building.

Hayden, Robert. Eight Black American Inventors. Reading, MA: Addison-Wesley Publishing Co., Inc., 1972.
It is important and interesting to know that shoe manufacturing, sugar refining, and truck refrigeration, railroad telegraphy, and other technological innovations were the work of black American inventors.

Keen, Martin L. Lightning and Thunder. New York: Julian Messner, 1969.
A description of a thunderstorm; how it begins, what lightning is made of, and how wind and water help start a thunderstorm.

Sootin, Harry. Experiments with Electric Currents. New York: Grosset and Dunlap, Inc., n.d.
A synopsis of the fundamentals of electricity, electric circuits, and magnetism.

Stone, A. Harris, and Ingmanson, Dale. Drop by Drop. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1968.
This book contains experiments designed to help young people learn about the physical and chemical properties of water.

Urquhart, David I. The Bicycle and How it Works. New York: Henry Z. Walck, Inc., 1972.
About friction, invention of the wheel, roller bearings, the function of gears and brakes, and a bit about balance. Of value whether or not the bicycle has already been mastered. Attractive illustrations.

---. The Internal Combustion Engine and How it Works. New York: Henry Z. Walck, Inc., 1973.
How the internal combustion engine was developed, how it works, and the great variety of ways in which it makes life easier. Good diagrams.

Valens, Evans G. Motion. Eau Claire, WI: E.M. Hale & Co., 1965.
This book presents examples common to the everyday experience of the reader in order to create a background and understanding of the scientific laws of motion.

Zim, Herbert, and Skelly, James. Tractors. New York: William Morrow and Co., Inc., 1972.
These slow, powerful machines work in the fields, factories, and mines and construct new roads and buildings. They are loaders, diggers, scrapers, pullers, and pushers that can even saw, drill, and pump. Good, simple physics.

CONTENT AREA

When matter changes from one form to another, the total amount of matter remains unchanged.

Berger, Melvin. The New Water Book. New York: Thomas Y. Crowell Co., 1973.
The characteristics of water; why it is essential for our existence. The many experiments are excellent and simple enough for a child to perform and understand the conclusions. There is also a list of several organizations interested in pollution.

Berry, James. Exploring Crystals. New York: Macmillan Co., 1969.
The science of crystallography tells why a metal is hard or soft, why solid glaciers flow, what liquid crystals are, why radium glows in the dark and other facts about crystals. It also provides home or classroom experiments and includes instructions for making instruments.

Buchanan, Alfred K., and Martin, William G. In Motion. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1968.
The physics of motion is demonstrated by a fictional character called Spymaster who is trying to find out what happened to a briefcase filled with documents. In the effort to recover the briefcase, the author introduces such concepts as speed, velocity, and kinetic energy.

Lefkowitz, R.J. Matter All Around You: A Book About Solids, Liquids and Gases. New York: Parents' Magazine Press, 1972.
Matter is defined and characteristics of the three states explored, as well as atoms, molecules, elements, and compounds. Text is refreshingly light but some of the concepts need concentration. Illustrations may not appeal to older children. A valuable introduction to chemistry.

Shalit, Nathan. Cup and Saucer Chemistry. New York: Grosset and Dunlap, Inc., 1972.
A well-planned book for youngsters who are fascinated with science and the "magic" of chemistry. Materials used are easily available in the home. Experiments are safe and can lead to a sense of satisfaction when completed.

Shepherd, Walter. Textiles. New York: John Day Co., Inc., 1972.
From spinning to dyeing, from wool, cotton, linen, and silk to the modern synthetic fibers, this beautifully illustrated book describes the main elements in the technology of woven materials.

Simon, Seymour. The Rock-Hound's Book. New York: Viking Press, Inc., 1973.
Anyone with curiosity can become a rock hound; this will help him to do so in a scientific manner. Where and how to look, and how to identify and organize a simple collection from city or country sources are clearly described and illustrated.

Stone, A.H., and Ingmanson, D. Crystals From the Sea: A Look at Salt. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1968.
Experiments are listed for the child using common table salt which teach the principles such as the relationship of temperature to solubility, state of matter, buoyancy, specific gravity, food preservation, physiology and crystallography.

Strache, Wolf. Forms and Patterns in Nature. New York: Pantheon Books, Inc., 1973.
This large collection of black and white photographs illustrates forms in nature and some of the visual parallels among them. There are aerial views of rivers, canyons, and sand dunes; close-ups of butterfly wings and shell markings; microscopic views of algae and crystals; and much more.

CONTENT AREA

Living things are interdependent with one another and with their environment.

Behnke, Frances. The Changing World of Living Things. New York: Holt, Rinehart and Winston, Inc., 1972.
Scientific concepts concerning the interrelationship of all living organisms with one another and with their environment are examined. Ecological terminology is clarified in this source book for the advanced child.

Blough, Glenn O. Discovering Cycles. New York: McGraw-Hill Book Co., 1973.
Well-planned and accurate explanation of the causes and effects of some cycles so vital to our lives, such as the seasons, the water cycle, and plant and animal cycles. Suggests several ideal experiments and observational activities. Complemented by Jeanne Bendick's outstanding illustrations.

Cousteau, Jacques-Yves. Oasis in Space. New York: World Publishing Co., 1972.
Many authors have written on oceanography for young readers, but none are better at popularizing this complex subject than is Cousteau. Oasis in Space is concerned principally with ecology and with the close relationships of the oceans and other waters on this planet.

---. Window in the Sea. The Art of Motion. New York: World Publishing Co., 1973.
These two books combine spectacular photography with an upper elementary to senior high school level text. Each book, in straightforward language, explores a variety of topics such as the dark underwater world and how it works; and structure and metabolism of propulsion.

Dahlberg, Charles Clay. From Food to Fertilizer: The Role of Excrement in the Life Cycle. Reading, MA: Young Scott Books, 1973.
The role of human and animal wastes in life cycles. Uses of animal wastes as fertilizers, in sewage disposal systems, as useful bacteria. The human digestive and urinary systems are included. Important information which is not easily available elsewhere.

Dowden, Anne. Wild Green Things in the City. New York: Thomas Y. Crowell Co., 1972.
The magnificent drawings and information about common weeds found in most cities, illustrating their special adaptations for survival in a smog-filled, unfriendly environment will make young readers aware of yet another ecological link.

Edsall, Marian. Battle on the Rosebush: Insect Life in Your Backyard. Chicago: Follett Pub. Co., 1972.
Spellbinding observations of the dramatic world of the backyard. Experiments are suggested which should sharpen the senses of youngsters who perform them.

Elliott, Sarah M. Our Dirty Air. New York: Julian Messner, 1971.
An interesting account of the plight of the public in the fight against air pollution and suggestions for young people in their own struggle to combat this menace. A description of how air pollution is affecting the weather, plants, animals, and other living things is included.

---. Our Dirty Water. New York: Julian Messner, 1973.
An outstanding book on the problems of water pollution. Water is an easily accessible commodity today that far too few people think about with any concern.

Eubank, Constance. Insect Zoo: How to Collect and Care for Insects. New York: Walker & Co., 1973.
There are a large number of available children's books on insects, but this one is still worthy of close attention. The author does a brief but excellent job of introducing insect study, with clear descriptions of insect characteristics, collecting techniques, and care and feeding of captured specimens.

Fenton, Carroll Lane, and Kitchen, Herminie B. Animals that Help Us: The Story of Domestic Animals. New York: John Day Co., Inc., 1973.
This is a newly revised edition of a popular series of short articles on domestic animals. Introductory remarks give a clear and basic review of the history of domestic animals.

Fletcher, Alan Mark. Fishes that Hide. Reading, MA: Addison-Wesley Publishing Co., Inc., 1973.
As implied in the title, the principal subject of this delightful little book is camouflage among fishes, but some other aspects of their ecology-mimicry, warning, coloration, and symbiotic relationships are briefly considered.

Freschet, Berniece. Pronghorn on the Powder River. New York: Thomas Y. Crowell Co., 1973.
A story told by a careful observer of the antelope's life, habits, and interrelationships with other creatures. An appealing book.

Harrison, Hal H. The World of the Snake. Philadelphia: J.B. Lippincott Co., 1971.
A collection of numerous pictures and drawings of snakes. Includes a checklist of over 100 American snakes.

Headstrom, Richard. Your Insect Pet. New York: David McKay Co., Inc., 1973.
Insects as pets? It is so easy once you understand what insects really are. The author gives an excellent briefing on the place of insects in the animal world.

Hess, Lilo. Mouse and Company. New York: Charles Scribner's Sons, 1972.
In this story we are taken on a "house hunting" expedition with a young female deer mouse. We discover the habits of the deer mice, how they build their homes, what they eat. We also learn how to catch and care for a mouse as a household pet. The story is enhanced with beautiful illustrations.

Hogner, Dorothy Childs. Birds of Prey. New York: Thomas Y. Crowell Co., 1969.
A good reference to help children to identify and understand the birds of prey and their place in the ecology.

Hoke, John. Terrariums. New York: Franklin Watts, Inc., 1972.
Various kinds of terrariums are covered in this fine exposition. Limitations of size, and flora and fauna best suited to a balanced ecosystem are discussed. Photographs enrich the text. Bibliography, materials list, index. A valuable reference book.

Hopf, Alice. Misunderstood Animals. New York: McGraw-Hill Book Co., 1973.
A much-needed book to dispel myths and misconceptions commonly held about certain animals, such as pigs, snapping turtles, and killer whales. Highly informative with an accurate insight into how these maligned ones fit into our environment.

Hutchins, Ross. Insects in Armor: A Beetle Book. New York: Parents' Magazine Press, 1972.
Excellent close-up photographs help to tell the story of the structure, habits, and life story of both common and unusual beetles. A straightforward scientific treatment appropriate to its audience.

Kaufman, John. Insect Travelers. New York: William Morrow and Co., Inc., 1972.
Interesting information not easily found elsewhere about migration habits of insects. Very helpfully illustrated. Includes maps, describes methods of research.

Marshall, James. Going to Waste: Where Will all the Garbage Go? New York: Coward, McCann and Geoghegan, 1972.
A vivid presentation of the ever increasing problem of waste disposal with its disastrous future if we fail to solve it. Photographic evidence of a growing horror. Concrete suggestions in recycling are presented to explain how these wastes can be controlled and even turned to our benefit.

Martin, Lynne. The Giant Panda. Reading, MA: Addison-Wesley Publishing Co., Inc., n.d.
Historical and biological information includes specific - but not dated - facts on pandas in zoos. Delightful photographs. Index, bibliography. Well worth reading.

Park, Ed. The World of the Otter. Philadelphia: J.B. Lippincott Co., 1971.
The physical characteristics of otters are discussed, including their environment, life cycle, gestation period, and eating habits.

Pringle, Laurence. From Pond to Prairie. New York: Macmillan Co., 1972.
Fascinating account of the life cycles of a pond and its inhabitants. Excellent material in conjunction with studies of populations, environments, communities, and ecosystems.

Pringle, Laurence. This is a River: Exploring an Ecosystem. New York: Macmillan Co., 1972.
Excellent diagrams and photographs enrich the brief text which presents concepts as well as information. Glossary, further reading, index. A good introduction to the study of water.

Schaeffer, Elizabeth. Dandelion, Pokeweed and Goosefoot. Reading, MA: Addison-Wesley Publishing Co., 1972.
Are weeds undesirable? Not so. Here the author reports on herbs and weeds of the woodland, pasture, and swampland used by Indians and early settlers of North America as food, medicine, or for household purposes.

Silverstein, Alvin, and Virginia B. Unusual Partners: Symbiosis in the Living World. New York: McGraw-Hill Book Co., 1968.
The unusual associations of animals, mutually helpful, parasitic, and harmful are discussed to widen the child's knowledge of animals.

Smith, Howard. Tracking the Unearthly Creatures of Marsh and Pond. Nashville: Abingdon Press, 1972.
Discursive, firsthand account of fauna - alligators to near-microscopic insects - found in wet places. Last chapter gives instructions for making a miniature pond. Glossary, detailed index, other books. Accurate illustrations add to informative text.

Tunis, Edwin. Chipmunks on the Doorstep. New York: Thomas Y. Crowell Co., 1971.
Excellent source to help the child to learn all about the life of a chipmunk.

Webster, David. Track Watching. Philadelphia: Franklin Watts, Inc., 1972.
A guide to observing and interpreting tracks of all kinds with directions for making a track collection and some track-puzzle illustrations. Interestingly written and helpfully illustrated with drawings and photographs.

Wright, Robert. What Good is a Weed? Ecology in Action. New York: Lothrop, Lee and Shepard Co., Inc., 1972.
This attractive book describes fifteen common weeds and explains how each is related to its environment. Shown and diagrammed are good and bad effects on man. The afterword contains information on ecological principles and scientific names. Index. Excellent photographs.

Zim, Herbert S. Armored Animals. New York: William Morrow and Co., Inc., 1971.
This book discusses the phenomenon of "armor" - a form of protection that nature has provided for some members of the animal kingdom. Examples are illustrated of armor both in vertebrates and invertebrates.

CONTENT AREA

A living thing is a product of its heredity and environment.

Berman, Lucy. Nature Thought of it First. New York: Grosset and Dunlap, Inc., 1972.
Special organic adaptations of animals and plants as jet propulsion, the camera eye, incubation, hypodermic needles (stingers), and many more upon which many of man's inventions have been broadly based are catalogued in interesting text and fascinating illustrations.

Blassingame, Wyatt. Wonders of Alligators and Crocodiles. New York: Dodd, Mead and Co., 1973.
Explains the four crocodilian groups, their range, habitats, habits, and breeding. Describes behavior in captivity and pleads for continued study of these reptiles threatened with extinction. Excellent photos.

Caras, Roger. Going to the Zoo with Roger Caras. New York: Harcourt Brace Jovanovich, Inc., 1973.
Interpretive guide about the purpose, organization, and operation of a zoo, including helpful do's and don'ts for the young visitor. Compares the four types of vertebrates usually found in zoos. Superb drawings by Cyrille Gretry enhance the descriptions of more than 200 animals.

Chester, Michael. Water Monsters. New York: Grosset and Dunlap, Inc., 1973.
The unique things of the world and especially the unique characteristics of living things are topics of interest to almost all young readers. The author of Water Monsters takes advantage of this fact and provides an enjoyable descriptive introduction to the strangers and the strangeness of the sea.

Chinery, Michael. Animal Communities. New York: Franklin Watts, Inc., 1973.
Chinery has assembled information on the social behavior of animals from a multitude of sources. Beginning with animal language and parental care, he develops the concept of an animal community for the young reader.

Cohen, Daniel. How Did Life Get There? New York: Julian Messner, 1973.
A thought-provoking book on dispersal of plants and animals centered on the isolated volcanic islands of Krakatoa, Surtsey, and the Galapagos, and on the island continent of Australia.

Cook, Joseph J., and Wisner, William L. Blue Whale, Vanishing Leviathan. New York: Dodd, Mead and Co., 1973.
This largest whale faces extinction. Its evolution, biological development, characteristics, and future are clearly traced and illustrated. There is a section on whaling. Emphasis on maintaining marine ecological balance.

Cooper, Elizabeth K. Sweet and Delicious: Fruits of Tree, Bush and Vine. Racine, WI: Western Publishing Co., Inc., 1973.
The large variety of fruits found in a city market provide the basis for this book. Their history, origin, identification, reproduction, and uses are illustrated with black and white photos. Simple recipes included.

Crowcroft, Peter. Australian Marsupials. New York: McGraw-Hill Book Co., 1972. One of a series of "Natural Science Picture Books" that describes and pictures the habits, life cycles, and development of common and uncommon marsupials. Large clear illustrations.

Evans, Eva K. The Dirt Book. Boston: Little, Brown and Co., 1969. This book tells how in the beginning our planet was mainly rock and water until the rocks began to break up and living cells came out of the oceans to help make them into dirt; how plants and animals came to live in dirt, and what they do for soil.

Fox, Michael. The Wolf. New York: Coward, McCann and Geoghegan, 1973. Exciting account of the life cycle and habits of wolves. An authoritative narrative corrects unfounded prejudices. Other animals benefit from their relationship with the wolf. Fascinating drawings by Charles Fracé.

Gallant, Roy. Charles Darwin: The Making of a Scientist. New York: Doubleday & Co., Inc., 1973. An absorbing account of Darwin's development from a "slow learner" to one of the world's great scientists. Despite questionable description of Fuegians, this is an important book when, once again, evolutionary thinking is faced with organized opposition.

Graham, Ada and Frank Jr. The Mystery of the Everglades. New York: Random House, Inc., 1972. The true story of eleven-year-old Jon's trip to the Everglades presented in narrative form. An absorbing account of the author's accurate, detailed observations; well-illustrated with photographs. The message, "Save the Everglades," is clear. Index included.

Hoke, Helen, and Pitt, Valerie. Whales. New York: Franklin Watts, Inc., 1973. Many aspects of whale study, past and present. Text is clarified by many fine photos and drawings. Experiments with dolphins are of special interest. An appendix on aquariums and whaling exhibits encourages further investigation.

Hutchins, Ross E. The Bug Clan. New York: Dodd, Mead and Co., 1973. This well-written, technically accurate book provides descriptions of two orders of insects: the Hemiptera and Homoptera, generally referred to as "the bugs."

---. The World of Dragonflies and Damselflies. New York: Dodd, Mead and Co., 1969. This book serves as a key to help children to identify and mount the dragonflies and damselflies.

Laycock, George. Air Pollution. New York: Grosset and Dunlap, Inc., 1972. Accurate facts and figures, causes and effects of air pollution presented in a very pleasing format; very readable with vivid, convincing pictures.

Lerner, Marguerite Rush. Who Do You Think You Are? The Story of Heredity. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1963.
Basic information on heredity: genes, chromosomes, and DNA; beginnings of human life and development of the embryo; inherited and acquired characteristics, eye, skin, and hair color.

LeShan, Eda. What Makes Me Feel This Way? New York: Macmillan Co., 1972.
This book will help children in the upper elementary grades to understand their feelings and to be able to begin to deal with them. It is extremely well-written and would be a most definite asset to any library.

Lowenherz, Robert J. Population. New York: Creative Education Press, 1970.
A close look at problems facing people today such as over-population, urbanization and pollution.

MacClintock, Dorcas. A Natural History of Giraffes. New York: Charles Scribner's Sons, 1973.
What is known about giraffes today - their behavior, their locomotion, and their spot patterns - is presented. There is a chapter on the Okapi, a giraffe relative. Striking paper cutout silhouettes by Ugo Mochi help make this an extraordinary book.

McKern, Sharon. The Many Faces of Man. New York: Lothrop, Lee and Shepard Co., Inc., 1972.
A very good introduction to physical and cultural anthropology. An extensive examination of race, the meaning of culture, social organization, division of labor, beliefs, learning, and human beings as members of one family. Well illustrated with photographs.

McNamara, Louise Greep, et al. Your Growing Cells. Boston: Little, Brown and Co., 1973.
Without straining for profundity, the book explains advanced microscopy, tissue differentiation and the functioning of cells, all the while encouraging the reader to "see for yourself." The universality of cells in all plants and animals is emphasized.

Naylor, Penelope. The Spider World. New York: Franklin Watts, Inc., 1973.
The African tale of "Anansi the Spider" is used to introduce the readers to the life of the spiders. To introduce the chapter on courtship and reproduction, Anansi appears again. The anatomy of spiders and their place in the animal kingdom are described.

Newell, Audrey. Sea Shells in Action. New York: Walker and Co., n.d.
An informative book written in simple terms. Twenty-five shells are described in detail with magnificent illustrations. One learns how shells receive their names, how the animals inside them mate, feed, and survive. The shell identification chart at the end of the book serves as a reinforcement.

Patent, Dorothy Hinshaw. Weasels, Otters, Skunks and Their Family. New York: Holiday House, Inc., 1973.
An informative account of the Mustelid family, how they live, cooperate with other members in the family, fight for survival, and how they have adapted to survive in different environments. A reading list at the end of the book is an added attraction.

Perry, Roger. The Galapagos Islands. New York: Dodd, Mead and Co., 1972.
Closeup of the curious archipelago and its bizarre animal inhabitants. Coherent information about an exotic locale.

Pomerantz, Charlotte. Why You Look Like You, Whereas I Tend to Look Like Me. Reading, MA: Young Scott Books, 1969.
Taking a look at the dominant and recessive characteristics. The mechanics of inheritance are explained.

Rhine, Richard. Life in a Bucket of Soil. Lothrop, Lee and Shepard Co., Inc., 1972.
After explaining how to collect a small world of soil, the author describes many of its inhabitants. He encourages experiments with soil dwellers so enthusiastically that he is sure to inspire students.

Robertson, Keith. In Search of a Sandhill Crane. New York: Viking Press, Inc., 1973.
In this novel, a young teenager from New Jersey spends a summer in the wilds of the Upper Peninsula of Michigan, where his persistence pays off in getting pictures of sandhill cranes. In so doing, he learns much about the beauty and drama of nature, and the significance of conservation.

Selsam, Millicent E. The Apple and Other Fruits. New York: William Morrow and Co., Inc., 1973.
The parts of a flower and their functions. Accurate explanation of how the apple and apple tree grow. The beautiful color photographs of the various fruit blossoms by Jerome Wexler are works of art.

Shuttlesworth, Dorothy E. To Find A Dinosaur. New York: Doubleday & Co., Inc., 1973.
Unlike most dinosaur books for young people, this one devotes a good deal of space to the human element in dinosaur study. In addition to a fine general discussion about dinosaurs themselves, the author covers some of the history of the people who developed the field, how and under what hardships they made their discoveries, professional rivalries, and other points which reveal the study of these extinct reptiles to be a living, human enterprise.

Silverstein, Alvin and Virginia. The Skeletal System: Framework for Life. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1972.
Excellent presentation and explanation of this system in clear and relatively simple terms. Excellent diagrams and comparisons. Explains functions of bones as a frame that is activated by the muscles. Illustrates similarities in various forms of animals.

Simon, Seymour. Discovering What Crickets Do. New York: McGraw-Hill Book Co., 1973.
Crickets' anatomy, life cycle, song; their individual and group life are all examined in this book. Simon also discusses more fanciful accounts of crickets. Simple observational experiments are interwoven in the text.

---. Science Projects in Pollution. New York: Holiday House, Inc., 1972.
An interesting insight into the problems of pollution through home experimentation. Materials used are simple, clean, and easily obtained. Includes insecticides, detergents, and nonbiodegradable substances.

Solandt, Barbara M. Children of the Ark. New York: University of Toronto Press, 1973.
Public interest in ecology and the widespread disappearance of wildlife has not focused on the increasingly important role of zoos in maintaining and breeding animals. This book brings some of these problems into focus, with excellent full-page black and white photographs of animals - mostly babies - and an emphasis on propagation of wild animals in captivity.

Stone, Harris, and Stein, Robert J. Biology Project Puzzlers. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1973.
Basic projects for young children. Materials used are inexpensive and safe. Sources for more project ideas, additional help, and materials are added attractions.

Waters, John. The Mysterious Eel. New York: Hastings House Publishers, Inc., 1973.
Discusses myths and facts and raises intriguing questions. Of particular interest is the search for the spawning ground and the unraveling of some of the mysteries about the life cycle and migratory habits of eels. Detailed drawings by Peter Zallinger.

Wise, William. The Strange World of Sea Mammals. New York: G.P. Putnam's Sons, 1973.
A most commendable presentation of facts for the young reader concerning vanished, vanishing, and flourishing sea mammals. The origin of sea mammals, the life cycle, environment and chance of survival against man and fellow creatures are well described.

Zim, Herbert S. Bones. New York: William Morrow and Co., Inc., 1969.
How bones grow, how they move, how they support our bodies and make it possible for us to walk, run, jump, and lift. Illustrations amplify the text and make clear concepts such as different rates of growth at different ages.

---. Your Stomach and Digestive Tract. New York: William Morrow and Co., Inc., 1973.
The structure and function of the human digestive tract are described in detail, along with a brief description of the bovine stomach and the avian stomach which points out how their specialized structures serve the eating habits of these animals.

CONTENT AREA

Living things are in constant change.

Anderson, John M. The Changing World of Birds. New York: Holt, Rinehart and Winston, Inc., 1973.
An ornothologist describes adaptations, habits, life cycles, food habits, and migration of birds. Ecology concepts are emphasized, interestingly written, illustrated by photographs.

Barr, George. Young Scientist and the Doctor. New York: McGraw-Hill Book Co., 1969.
A descriptive progression of the medical techniques of curing human ills and increasing the life expectancy. Going through the process of examination and diagnosis, injections, treatments, medication, etc., the child gets an insight into the medical science.

Davis, Bette J. Winter Buds. New York: Lothrop, Lee and Shepard Co., Inc., 1973.
How to recognize and identify trees, shrubs, and vines by the pattern, shape, and texture of their buds in winter. Clearly illustrated and presented in an informative manner.

Ford, Barbara. Can Invertebrates Learn? New York: Julian Messner, 1972.
Remarkably challenging material which stresses experimentation and personal observation to determine whether invertebrates can or cannot learn. Lists of materials needed for experiments are included.

Gallob, Edward. City Rocks, City Blocks and the Moon. New York: Charles Scribner's Sons, 1973.
The intent of this book is to encourage city children to observe and collect rocks that are found in the city. The descriptions of the three categories of rocks - igneous, sedimentary and metamorphic - should be understandable to any child with a reasonably wide vocabulary, although words like quartz and texture are used.

Greene, Carla. How Man Began. Indianapolis: Bobbs-Merrill Co., n.d.
The fascinating story of man's evolution beginning fifty million years ago. The reader joins scientists as they trace life from early mammals to modern man through fossils and artifacts that have been unearthed. Scientific terms are defined, pronunciations given, and the book also contains fine black and white illustrations.

Mathews, William H. The Story of Volcanoes and Earthquakes. Irvington-on-Hudson: Harvey House, Inc., 1969.
An account depicting the role earthquakes and volcanoes have played in shaping the face of the earth - told from Pompeii to the quake in 1968 that wrecked Iran.

Shuttlesworth, Dorothy E. To Find A Dinosaur. New York: Doubleday & Co., Inc., 1973.
Unlike most dinosaur books for young people, this one devotes a good deal of space to the human element in dinosaur study. In addition to a fine general discussion about dinosaurs themselves, the author covers some of the history of the people who developed the field, how and under what hardships they made their discoveries, professional rivalries, and other points which reveal the study of these extinct reptiles to be a living, human enterprise.

Silverstein, Alvin and Virginia. Cancer. New York: John Day Co., Inc., 1972.
Begins with a discourse on the normal body and how it functions. Once the reader understands the workings of the normal body, then the subject of cancer is discussed. There is also a very readable chapter on research.

---. The Chemicals We Eat and Drink. Chicago: Follett Pub., Co., 1973.
A brief discussion of the food we eat starts this book on a positive note. Then the authors begin the grim account of the various chemicals that are added to our food supply, advertently or inadvertently. They discuss the natural poisons found in common foods such as carrots, celery, spinach, rhubarb, and potatoes; aflatoxins produced by fungi; marine toxins; and excessive amounts of Vitamin D.

Sootin, Harry. Gregor Mendel: Father of the Science of Genetics. New York: Vanguard Press, Inc., 1958.
An account of the life of Gregor Mendel, with simple and systematic explanation of the laws of inheritance which he formulated as a result of painstaking breeding of the garden pea.

Waters, John. Some Mammals Live in the Sea. New York: Dodd, Mead and Co., 1972.
Factual and informative summary of the life, habits, and habitat of a variety of aquatic mammals and their prospects for survival. Interesting accounts of man's experience with them. Delightful pictures for all ages.

CONTENT AREA

The universe is in constant change.

Adler, Irving. Time in Your Life. New York: John Day Co., Inc., 1969.
A story dealing with natural and man-made clocks including the rhythms of nature, the history of the modern calendar, time zones, and the use of clocks to estimate the age of the earth.

Angrist, Stanley W. Other Worlds, Other Beings. New York: Thomas Y. Crowell Co., 1973.
Is life on earth the only life in the universe? Carefully developed information about what we already know about the nature and development of life, conditions in the universe, theories, and a concluding section on how man explores to solve mysteries of other worlds and life.

Branley, Franklyn. The Beginning of the Earth. New York: Thomas Y. Crowell Co., 1972.
Dramatic illustrations set the mood for the awesome forces which gradually transformed swirling masses of gas into our hot-centered, "solid" planet Earth with its rocks, mountains, valleys, and oceans. An exceptional treatment of a difficult topic.

Brindze, Ruth. Hurricanes: Monster Storms from the Sea. New York: Atheneum Publishers, 1973.
Beginning with a dramatic and accurate description of the 1969 storm "Camille," Brindze provides both current and historical information on hurricanes. The use of satellite pictures is an important feature of this and later chapters.

Gallant, Roy A. Exploring the Planets. New York: Doubleday & Co., Inc., 1967.
This book gives the child a brief account of the history of astronomy followed by a detailed description and discussion of the planets.

Jacobs, Lou, Jr. Space Station Eighty. New York: Hawthorn Books, Inc., 1973.
The new developments in space exploration, with details of the Skylab launching, including the design, launch, and use of space stations as well as maintenance problems. Excellent photographs. Bibliography of readings.

Knight, David C. The Tiny Planets: Asteroids of Our Solar System. New York: William Morrow and Co., Inc., 1973.
In an interesting discussion of the discovery, composition, origin, and possible uses of the asteroids, the author captures the spirit of adventure that was an important factor motivating 19th century astronomers in their search for the elusive objects that populate the region between Mars and Jupiter.

Ley, Willy. Gas Giants - The Largest Planets. New York: McGraw-Hill Book Co., 1969.
A book that may answer the many questions concerning Jupiter, Saturn, Uranus, Neptune, and Pluto.

Nourse, Alan E. The Backyard Astronomer. New York: Franklin Watts, Inc., 1973.
Guide to the observation of the major constellations, the moon's surface, the motion of the planets, solar and lunar eclipses. Techniques for using the unaided eye, binoculars, and homemade equipment.

Ubell, Earl. The World of Candle and Color. New York: Atheneum Publishers, 1969.
The child learns of the properties of light, how it travels, passing through space and air, how it is diffused or blocked, and how light behaves.

Weiss, Malcolm E. Storms From the Inside Out. New York: Julian Messner, 1973.
Weiss has written an excellent juvenile book on hurricanes, tornadoes, cyclones, thunder, lightning, and clouds. The illustrations and photographs are well conceived and executed, and the word descriptions of the formation of the weather processes tie in well with the pictures.

Appendix B

Area Science Specialist's

Traveling Library of Sourcebooks

Activities for science are described in a wide variety of source materials listed in Appendix B. Library resource books, textbooks, pamphlets, and teachers' guides are available to classroom teachers on a short-term loan basis. Most often the science teacher specialist will make suggestions to individual teachers as they work together on a specific part of the science program. Consult your area science teacher specialist for assistance. Some libraries will also have the titles listed here in their general collections, and in that case they will be included in the card catalog index.

Sample Entry

(Number represents alphabetical listing by title)
↓
0.50 Activity Wheels, ESS, McGraw-Hill, New York, 1969.
599 ELE
↑
(Library Call Number)

0.50 Activity Wheels, ESS, McGraw-Hill, New York, 1969
599 ELE
This unit involves children in a direct study of the activity of small animals. It introduces several techniques for observing and measuring animal behavior under different conditions.

1.00 Adaptations, EIS, McGraw-Hill, New York, 1967
574.5 ADA
This unit concerns some of the ways in which living things are adapted to physical and biological factors in their environment.

2.00 Adventures With Freshwater Animals, Headstrom, Richard, J.B. Lippincott
591.92 HEA Co., Philadelphia, 1964
Forty-seven "adventures" into the lives of animals living in, on, and near freshwater are presented. Each "adventure" is a separate experiment, fully explained, and illustrated.

3.00 Adventures With Insects, Headstrom, Richard, J.B. Lippincott Co.,
595.7 HEA Philadelphia, 1963
Forty-one "adventures" make up this introduction to entomology. Each is fully illustrated and simple experiments are described.

4.00 Air, EIS, McGraw-Hill, New York, 1967
533 AIR
This unit introduces the concept that even though we cannot see air, it it occupies space, exerts pressure, and is always all around us.

6.00 Animals in the Classroom, ESS, McGraw-Hill, New York, 1970
636 ELE
A book for teachers. Advises teachers of the preparations needed for maintenance of live animals: caging, feeding, and other environmental requirements.

7.00 A Packet of Material on Arbor Day for Maryland
394.2 ARB
This booklet includes chapters on Types of Arbor Day Plantings, Outline Guide for Arbor Day Plantings, Arbor Day Program Work Guide for Arbor Day Plantings, History of Arbor Day, Arbor Day Recitations, Arbor Day Poems, Arbor Day Songs, Quotations for Arbor Day, Selected Bibliography, and How to Plant Ornamental Trees and Shrubs. Suggestions for activities other than tree and shrub planting are listed.

8.00 Atmosphere and Weather, EIS, McGraw-Hill, New York, 1967
551.5 ATM
This unit relates such atmospheric characteristics as barometric pressure, relative humidity, and wind velocity to actual weather conditions.

9.00 Atoms and Molecules, Trieger, Seymour 2nd edition, Teachers Pub. Corp.,
541 TRI Darien, CT, 1964
Activities are keyed to varying abilities. Questions are used in several different ways. At the beginning of each chapter is a list of questions children of different ages might ask. Other questions with answers are included in each activity to help teachers guide students. More questions are included later as open-ended activities. Each chapter concludes with a summary of the main ideas.

10.00 Attribute Games and Problems, ESS, McGraw-Hill, New York, 1968
153.2 ELE
This unit provides an opportunity for children to deal with problems of classification and the relationship between classes. The kinds of problems worked on here lend themselves to applications in many curriculum areas--science, social studies, mathematics, or wherever classification and dealing with relations between classes are called for.

11.00 Attribute Games and Problems, Materials, ESS, McGraw-Hill, New York, 1968
153.2 ELE
The blocks, the people pieces, and the color cubes for use with activity cards immediately below.

12.00 Attribute Games and Problems, Problem Cards, ESS, McGraw-Hill, New York,
153.2 ELE 1968
Sequential problems and activities for the unit. There are 39 cards for use with A-Blocks; 17 for Color Cubes; 16 for People Pieces; and 15 Creature Cards.

12.50 Balance Book, ESS, McGraw-Hill, New York, 1969
531 ELE
Primary Balancing unit affords children the opportunity to explore balancing and weighing at first hand.

13.00 Balanced Forces, EIS, McGraw-Hill, New York, 1967
531 BAL
This unit is concerned with forces that are in equilibrium and the way in which such forces affect a body at rest.

14.00 Balances, EIS, McGraw-Hill, New York, 1967
531 BAL
This unit helps the pupils to understand that weighing is comparing masses and that any useful set of "standard" masses can be used as units of measure.

15.00 Balloons and Gases, ESS, McGraw-Hill, New York, 1971
533 ELE
Gives children an opportunity to prepare and collect gases and to discover some of their properties. Preliminary work is done with

acids and bases and a colored indicator, bromothymol blue. Students generate a number of common gases and conduct tests which enable them to distinguish the gases from one another.

16.00 Batteries, EIS, McGraw-Hill, New York, 1967
537 BAT
This unit introduces the pupils to electricity. By using a battery and wires to construct various electrical circuits, children develop the understanding that electricity can be used to produce light, heat, magnetic force, and sound.

17.00 Batteries and Bulbs, ESS, McGraw-Hill, New York, 1968
537 ELE
An introduction to the study of electricity and magnetism. In the course of this study, each child carries out experiments with simple and safe equipment--flashlight batteries, small bulbs, various kinds of wire, magnets, and a compass--and draws conclusions based on his observations.

18.00 Batteries and Bulbs II, ESS, McGraw-Hill, New York, 1971
537 ELE
This resource book contains illustrated suggestions for almost fifty different battery-operated gadgets and projects. All of the gadgets are relatively simple and can be constructed with simple tools from common scrap materials. The gadgets are intended to be used as a source of ideas, rather than as models to be copied.

19.00 Behavior of Mealworms, ESS, McGraw-Hill, New York, 1966
595 ELE
This book stimulates children to ask questions about the observable behavior of an unfamiliar animal and then directs them to ways of finding the answers for themselves. As children observe and experiment, they learn some things about the process of scientific inquiry.

20.00 Behavioral Objectives in the Affective Domain, Eiss, Albert, and Harbeck,
370.15 EIS Mary Blatt, National Science Teacher's Association,
Washington, D.C., 1969
The purpose of this monograph is to provide some insight into ways objectives in the affective domain can be behaviorally stated and present some examples.

21.00 Bone Picture Book, ESS, McGraw-Hill, New York, 1968
574.1 ELE Supplementary Science Reader
Designed as part of the Elementary Science Study unit on bones, this book of pictures helps students become familiar with a variety of bones and notice the similarities and differences.

22.00 Bones, ESS, McGraw-Hill, New York, 1968
574.1 ELE
This unit involves students in activities with bones and skeletons of many kinds. In the course of their study, the children learn much about the skeletal system. Of even greater importance is the opportunity they have to become familiar with a variety of bones and their structure, noticing the similarities and differences among them, and experiencing the satisfaction of assembling skeletons of their own.

23.00 Brine Shrimp, ESS, McGraw-Hill, New York, 1969
595 ELE
Brine shrimp are small, salt-lake crustaceans, easily hatched and cared for in any classroom and fascinating to study. Children can easily watch their own animals hatch, grow, and eventually have young of their own. Each child, working alone or with a classmate, can raise and maintain his own brine shrimp.

24.00 Budding Twigs, ESS, McGraw-Hill, New York, 1970
581.1 ELE
Gives children an opportunity to examine in the classroom the structure of twigs and the development of buds forced into bloom ahead of season. Through observation and dissection, children become aware of the varieties and complexities of plant structure. They are encouraged to collect twigs and to try to predict what the buds will become.

25.00 Butterflies, ESS, McGraw-Hill, New York, 1970
595.7 ELE
While watching their own animals and caring for them, children not only learn about the biological process of metamorphosis, but they also learn to care for and protect a living creature. Although the main focus of this unit is on butterflies, the study may include moths also. The children can discover the similarities and differences of these related creatures.

26.00 Changes, ESS, McGraw-Hill, New York, 1968
500 ELE
This unit gives children an opportunity to see, distinguish, and understand something about the changes in organic and inorganic substances that are caused by the growth of living organisms, such as bacteria, as well as those brought about by nonliving processes, such as rusting and melting.

27.00 Chemical Change, EIS, McGraw-Hill, New York, 1967
541 CHE
This unit enables the pupils to observe for themselves the properties of certain chemical compounds and to recognize four signs of chemical change (reaction).

28.00 Clay Boats, ESS, McGraw-Hill, New York, 1969
532 ELE
Children investigate the possibility of making a lump of clay float in a container of water. The children make shapes out of the clay, and, when they have made a shape that floats, they experiment to see how much "cargo" their "boats" will hold.

29.00 Color, EIS, McGraw-Hill, New York, 1967
535 COL
In this unit, the pupils study the effect of prisms, diffraction gratings, and colored filters on light.

30.00 Colored Solutions, ESS, McGraw-Hill, New York, 1968
541 ELE
This unit utilizes food coloring, water, salt, and transparent containers to introduce children to ideas associated with density and the layering of liquids.

31.00 Communities, SCIS, Rand McNally and Co., Chicago, 1971
574 SCI
Pupils investigate the food-energy relationship. They infer that food produced by photosynthesis is transferred along the food chain to all organisms. The concepts of decomposers, raw materials, producers, consumers, reproduction, community, and food web are also presented. Communities is designed for fifth grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

32.00 COPES--Water-Mix Experiments, COPES, American Science & Engineering,
536 CON New York, 1972
The experiments in this booklet are presented as a series of classroom activities forming a unit related to conservation of energy. It is designed to acquaint teachers with the philosophy of the COPES program which focuses the child's attention on certain of the "big ideas" in science in terms of which the scientific community seeks to account for the familiar facts of nature. The activities are designed for grades three to four.

33.00 Continuity of Life, EIS, McGraw-Hill, New York, 1967
574.3 CON
In this unit, the pupils investigate the embryonic development of the chicken. They learn that all life comes from preexisting life; that animals develop into complex organisms from one or more cells; and that physical factors in the environment can affect the development of the embryo.

34.00 Crayfish, ESS, McGraw-Hill, New York, 1969
597 ELE
Crayfish are interesting and manageable animals to keep in a classroom. Children enjoy handling crayfish and investigating their behavior.

35.00 Curious Gerbils, The, ESS, McGraw-Hill, New York, 1967
636 ELE
Written for young readers (approximately fourth grade and up) this book includes general information about gerbils with emphasis on care. A list of supplies is included.

37.00 Daytime Astronomy, ESS, McGraw-Hill, New York, 1971
523 ELE
This unit is built around children's observations of the shadows the sun casts on the earth at different times of the day and throughout the year. Children become familiar with the apparent motion of the sun by recording changes in the length and direction of the sun's shadows.

38.00 *Discover the Stars*, Johnson, G., and Adler, I., Sentinel Books, New York, 1965
523 JOH

This book furnishes material for science projects such as making a planetarium in a bottle, telling time by the Big Dipper, regulating your watch by the stars, finding latitude by the Pole Star, making a sundial, and making a sextant. Explanations for the causes of seasons and the longest and shortest days as well as the source of the month and week are presented. A chapter entitled "How to Use a Telescope" includes basic principles of optics, kinds of telescopes, how to choose a scope, how to sight, how to care for a scope, and how to build a simple refractor.

39.00 *Discovery Lessons: The Biological Sciences*, Sund, Robert, Tillery, B.W., and Trowbridge, L.W., Allyn and Bacon, Boston, 1970
574 SUN

This book is comprised of one hundred activities for teaching biological science in the elementary school. Each activity includes a list of materials, grade level range for which it is most suitable, discussion questions, suggested steps in pupil investigation, conceptual scheme, process objectives, concepts, cognitive behavioral objectives, teacher's notes, and open-ended possibilities.

40.00 *Discovery Lessons: The Earth Sciences*, Sund, Robert, Tillery, B.W., and Trowbridge, L.W., Allyn and Bacon, Boston, 1970
550 SUN

This book is comprised of one hundred activities for teaching earth science in the elementary school. Each activity includes a list of materials, grade level range for which it is most suitable, discussion questions, suggested steps in pupil investigation, conceptual scheme, process objectives, concepts, cognitive behavioral objectives, teacher's notes, and open-ended possibilities.

41.00 *Discovery Lessons: The Physical Sciences*, Sund, Robert, Tillery, B.W., and Trowbridge, L.W., Allyn and Bacon, Boston, 1970
500.2 SUN

This book is comprised of one hundred activities for teaching physical science in the elementary school. Each activity includes a list of materials, grade level range for which it is most suitable, discussion questions, suggested steps in pupil investigation, conceptual scheme, process objectives, concepts, cognitive behavioral objectives, teacher's notes, and open-ended possibilities.

42.00 *Drops, Streams, and Containers*, ESS, McGraw-Hill, New York, 1971
532 ELE

In this unit children investigate to answer their own questions about flowing, dripping, floating, and other properties of liquids--how drops of water behave on various surfaces, what happens when one liquid is poured into another, and different ways of getting them from one container to another.

43.00 The Earth, Hubbell, Lawrence, Teachers Pub. Corp., Darien, CT, 1964
551 HUB
Activities are keyed to varying abilities. Questions are used in several different ways. At the beginning of each chapter is a list of questions children of different ages might ask. Other questions with answers are included in each activity to help teachers guide students. More questions are included later as open-ended activities. Each chapter concludes with a summary of the main ideas.

44.00 Earth and Sun, EIS, McGraw-Hill, New York, 1967
525 EAR
This unit introduces the concept that no matter where a person lives, it is somewhere on the earth. The children determine experimentally that the higher up you go, the more things you can see and also that far-off things look smaller than when they are nearby.

45.00 Earth in Space, The, Erickson, Jay W., Teachers College Press, New York, 1965
550 ERI
The Science Manpower Project divides the science concepts taught in grades K through 6 into six categories. One of these is The Earth in Space. This book supplies the background information needed by the teacher. Each chapter begins with an analysis of the concepts; considers the ways and means of teaching a unit; describes a series of relatively simple demonstrations and experiments.

46.00 Earth, Sun, and Seasons, EIS, McGraw-Hill, New York, 1967
525 EAR
This unit explains day, night, and the seasons in terms of the rotation of the earth on its axis and its yearly revolution around the sun.

47.00 Earthworms, ESS, McGraw-Hill, New York, 1971
595 ELE
Children learn directly about the habits and developmental stages of a living creature and develop confidence in their ability to find out things about an animal by themselves.

48.00 Ecology, EIS, McGraw-Hill, New York, 1967
574.5 ECO
In this unit the pupils study a small plot of ground, survey its contents, and note the changes which occur on the plot over a period of time.

49.00 Ecosystems, SCIS, Rand McNally and Co., Chicago, 1971
574.5 SCI
The term ecosystem is introduced as pupils observe organisms in their aquarium-terrarium systems interact with their environment. Cycles such as water, oxygen-carbon dioxide, and food-mineral are presented. In the last part of the unit, various aspects of water pollution are investigated. Ecosystems is designed for sixth grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

50.00 Eggs and Tadpoles, ESS, McGraw-Hill, New York, 1969
597 ELE

This unit encourages children's natural interest in living things through the exploration of frog eggs and tadpoles. Whether the eggs are collected from a pond or purchased from a supplier, they are exciting to watch as they change in a few days from nondescript blobs to living, swimming animals.

51.00 Electricity, EIS, McGraw-Hill, New York, 1967
537 ELE

In this unit pupils produce electricity by using chemical energy (wet cells) and kinetic energy (electromagnetic induction).

52.00 Elementary Science Sourcebook, SCIS, Rand McNally and Co., Chicago, 1968
507 SCI

This book is divided into three parts. The Introduction describes the background of the SCIS program which is based upon the structure of science as seen by modern scientists and is consistent with a modern view of the nature of intellectual development of children. Educational Foundations discusses psychology and education, concern for the nature and structure of science, demands of society, and changes in the nature of the child's environment and illustrates their influences on the SCIS program. In Scientific Foundations the nature of operational definitions and how they are used in science is described, and some specific examples of how operational definitions are used in SCIS are discussed.

53.00 Energy in Waves (also titled Energy and Waves), Cox, Louis T., Teachers
531 COX Pub. Corp., Darien, CT, 1964

Activities are keyed to varying abilities. Questions are used in several different ways. At the beginning of each chapter is a list of questions children of different ages might ask. Other questions with answers are included in each activity to help teachers guide students. More questions are included later as open-ended activities. Each chapter concludes with a summary of the main ideas.

54.00 Energy Sources, SCIS, Rand McNally and Co., 1971
531 SCI

The new concepts of energy sources, energy transfer, and energy receivers are explored through rotoplanes, warm and cold water, stopper poppers, rolling spheres, melting ice, dissolving of solid sodium thiosulfate, and dissolving of anhydrous magnesium sulfate. The concept of energy chain is introduced. Energy Sources is designed for fifth grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

54.5 Environmental Education in the Elementary School, Shugrue, S.K.,
574.5 SHU National Science Teacher's Association, Washington, D.C., 1972

This collection of articles from Science and Children presents information on ecology as well as techniques for increasing children's awareness of their environment. Ideas are presented for use of the neighborhood in outdoor education. Plans for field trips and on site investigations are outlined. Each article includes a bibliography.

55.0 Environments, SCIS, Rand McNally and Co., Chicago, 1970
574.5 SCI
Pupils correlate environmental factors in their terraria with the growth and survival of the organisms. The concept of optimum range is investigated. The activities are also directed to the school surroundings so pupils may infer relationships between seasonal changes in environmental factors and changes in plants and animals. Environments is designed for fourth grade and is part of the inquiry-centered, conconceptually-structured SCIS program.

56.00 Experimentation and Measurement, Youden, W.J., Scholastic Book Service,
502.8 YOU 1962
The three types of information presented are subject matter, research frontiers and methods, and student activities. Written as resource and enrichment material for junior and senior high school students, the book is also of interest and value to teachers.

57.00 Experiments on Animal Activity, ESS, McGraw-Hill, New York, 1969
591 ELE
An account of actual experiments performed by biologists investigating the activity of mammals. The case studies give children a sense of the value and interest of their own investigations. (A student booklet)

59.00 The Faithful Eye of Robert Hooke, ESS, McGraw-Hill, New York, 1966
578 ELE
This adaptation of Micrographia, an original work by Robert Hooke, contains direct quotes and photographs of his drawings. The reading level is suitable for fourth grade and above.

60.00 Field Study Manual for Outdoor Learning, Milliken, M., Hamer, A., and
371.3 MIL McDonald, E.C., Burgess Pub., Minneapolis,
1968
This book first presents an introduction to field study. The following five chapters cover the study of soil, water, plants, animal life, and weather. Each chapter includes general information, field study recordings, a list of words, suggested special interest projects, and data sheets for these projects.

61.00 Gases and "AIRS", ESS, McGraw-Hill, New York, 1967
533 ELE
This unit is composed of closely linked laboratory experiments investigating the nature of air and the changes it undergoes when interacting with common objects in our environment.

62.00 Geo Blocks, ESS, McGraw-Hill, New York, 1969
516 ELE
The Geo Blocks are a set of sanded unpainted hardwood blocks small enough to be used on school desks. They come in a wide range of shapes and sizes that make possible a great variety of structures and designs, both simple and complex. Teachers have used the blocks for city planning and other activities in connection with social studies, science, and reading.

63.00 Geologic Processes, EIS, McGraw-Hill, New York, 1967
551 GEO
This unit is concerned with a study of the properties of some specimens from the earth's crust and the processes which change the crust of the earth.

64.00 Geology and Earth Sciences, Sourcebook, Heller, R.L. Editor, Holt
550.7 AME Rinehart & Winston, New York, 1962
Designed to furnish resource material for teachers at all levels, this book contains 23 chapters on the following topics: minerals, rocks, volcanoes, metamorphism, earthquakes and the earth's interior, structural geology and mountain building, atmospheric science, weathering, water--its reservoirs and work, glaciers, mineral resources, engineering and military geology, astronomy, origin of the earth, paleontology, stratigraphy, sedimentation, field trips and methods, topographic maps, geographic maps, geologic topics for biology courses, geologic topics for chemistry courses, and geologic topics for physics courses. Each chapter includes suggested problems and questions, demonstrations, projects, and experiments as well as teaching aids.

65.00 Graphic Communication in Science, Guidry, Nelson, Frye, K.B., NEA,
502.8 GUI Washington, D.C., 1968
The original idea for this publication was inspired by the needs of junior and senior high school students who are engaged in the planning, conducting, and reporting of independent research-type investigations. The reader is introduced to graphic presentation of data, planning and techniques, and supplies and methods that make the work easier and more attractive.

66.00 Groups, EIS, McGraw-Hill, New York, 1967
577 GRO
This unit is concerned with classifying and grouping, an important aspect of science. The distinction between living and nonliving things is used as the most all-inclusive basis for classification. The ability to grow and the ability to reproduce are properties considered to be unique to living things.

67.00 Growing Seeds, ESS, McGraw-Hill, New York, 1967
582 ELE
This unit gives young children an opportunity to become acquainted with science, an opportunity to discover ways to find answers to their own questions about the world.

68.00 Heat, EIS, McGraw-Hill, New York, 1967
536 HEA
This unit introduces the concept of heat as a form of energy. Phase changes (solid to liquid, liquid to gas, etc.) are accompanied by a transfer of heat.

69.00 Heating and Cooling, ESS, McGraw-Hill, New York, 1971
536 ELE
Using small candles as the source of heat, children have heat "races" to see which material gets hot or cools fastest and devise ways to time the rate at which heat travels through rods and other pieces of metal.

69.50 Heating and Cooling, Problem Cards, ESS, McGraw-Hill, New York, 1971
536 ELE
The problem cards raise questions that children may not think of themselves. One card asks, "Without blowing on the candle flame or touching the wick, can you put out the flame by using a single piece of copper wire?" Another asks children to cut metal into various shapes and predict before testing them which will conduct heat more quickly.

70.00 Helping Children Learn Science, Hopman, Anne, National Science Teacher's Association, Washington, D.C., 1966
507 HOP
This collection of articles from Science and Children presents objectives for teaching science, background information for the teacher of science, resources for teaching-learning, classroom teaching-learning experiences, and experimental science curriculum studies.

71.00 Hot and Cold, EIS, McGraw-Hill, New York, 1967
536 HOT
The purpose of this unit is to introduce and develop the idea that a more accurate measurement of "hot," "warm," or "cold" than that obtained by sense perception is often useful or necessary.

72.00 How A Moth Escapes From its Cocoon, ESS, McGraw-Hill, New York, 1968
595.7 ELE
Written for the student fifth grade and above. This description of how a scientist researched the emergence of the silk moth from its cocoon is designed to give a realistic picture of what it is like and what it takes to be a research scientist. It might also encourage frustrated beginners by pointing out that uncertainty and failure are essential and exciting elements of research.

73.00 How Barn Owls Hunt, ESS, McGraw-Hill, New York, 1968
598.2 ELE
One of the reasons this book was written was to give the young reader (fifth grade and above) some idea of how a scientist--in this case a biologist--tries to solve a problem that interests him.

74.00 How to . . . Care for Living Things in the Classroom, Pratt, Grace K., NEA, Washington, D.C., 1965
574 PRA
The purpose of the booklet is to give simple but adequate information to teachers who wish to have plants and animals in the classroom. A bibliography is included.

75.00 How to . . . Evaluate Science Learning in the Elementary School, Blackwood, P.E., and Porter, T.R., NEA, Washington, D.C., 1968
507 BLA
Suggestions on ways of evaluating methods and attitudes as well as specific knowledge and its application are presented. A bibliography is included.

76.00 How to . . . Individualize Science Instruction in the Elementary School, Munch, Theodore W., NEA, Washington, D.C., 1966
507 MUN
One objective of this publication is to present examples of science teaching techniques and situations which provide maximum opportunity

for each child to practice the skills basic to science. These techniques are the means of individualizing science instruction. A bibliography is included.

77.00 How to . . . Plan and Organize Team Teaching in Elementary School Science, York, L.J., NEA, Washington, D.C., 1969
507 YOR
Team teaching involves a group of teachers with diverse capabilities who share an expanded number of students. Suggestions cover the membership of a science team, planning and organization, and evaluation. A bibliography is included.

78.00 How to . . . Record and Use Data in Elementary School Science, Petty, Mary C., NEA, Washington, D.C., 1965
507 PET
This booklet discusses how the technique of record-keeping can be used to develop rational powers and implement the process goals of science instruction. A bibliography is included.

79.00 How to . . . Teach Measurements, Holmes, Neal J., and Snoble, Joseph J., NEA, Washington, D.C., 1969
502.8 HOL
This booklet is primarily concerned with how to help youngsters develop concepts about measurement and how to make useful measurements in science activities. A bibliography is included.

80.00 How to . . . Teach Science Through Field Studies, Hurd, Paul D., NEA, Washington, D.C., 1965
507 HUR
This booklet gives suggestions for planning a field study, including preparation of a study guide, selection of a site, follow-up and evaluation. A bibliography is included.

81.00 How to . . . Use Behavioral Objectives in Science Instruction, Koran, J.J., Montague, E.J., and Hall, G.E., NEA, Washington, D.C., 1969
507 KOR
This publication is designed to describe one tool, behavioral objectives; discuss their use; and show their relationship to general instruction.

82.00 How to . . . Utilize the Services of a Science Consultant, George, Kenneth D., NEA, Washington, D.C., 1966
507 GEO
Suggestions for utilizing a science consultant include taking the initiative to invite him into the classroom, confer on ways to improve teaching methods, request advice on specific problems, plan together for needs of special group or individual students, keep in touch about special activities such as field trip, request equipment, participate in in-service, get help with personal professional development. A bibliography is included.

83.00 How to Lead a Field Trip, Youngpeter, John M., Gresham, H.L., and Amos, F.C., Ward's Nat. Science EST., New York, 1970
500.1 YOU
This booklet is intended primarily for the teacher who wishes to use the field trip as an adjunct to the classroom and laboratory but needs some help in the logistics of field trips and who may desire a few suggestions as to subject matter.

84.00 How to Make a Chicken Skeleton, ESS, McGraw-Hill, New York, 1965
574.1 ELE
This book written for the intermediate level reader tells him all he needs to know about preparing a chicken skeleton as part of the Elementary Science Study unit on bones.

85.00 Hunting with the Microscope, Johnson, Gaylord, Sentinel Books, New York,
578 JOH 1963
Written as a beginner's guide, this book covers the choice and care of a microscope; the making of slides; study of cells; preparation of cultures; study of microscopic plants and animals; and study of bacteria, yeasts, and molds as well as project source material. Forensic medicine is also introduced.

86.00 Ice Cubes, ESS, McGraw-Hill, New York, 1969
536 ELE
This unit asks questions to which children can find answers through direct experimentation. The students experiment with ice cubes to determine which factors influence the rate at which ice melts.

87.00 Illustrated Handbook of Some Common Molds, ESS, McGraw-Hill, New York,
589 ELE 1965
Photographs of ten of the most common molds are included. The molds included are the ones most likely to be encountered in Microgardening. Instructions for identifying molds are given.

88.00 Interaction and Systems, SCIS, Rand McNally and Co., Chicago, 1970
507 SCI
Interaction, central concept of the entire SCIS program, is introduced in the first unit. Pupils investigate pulley systems, dissolving, magnetism, and electric circuits. Interaction and Systems is designed for second grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

89.00 Introduction to the Elementary Science Study, ESS, McGraw-Hill, New
507 ELE York, 1966
The Elementary Science Study units differ widely drawing on many areas of the natural sciences and mathematics. All these units share the common approach to the teaching of science that helps each child investigate the nature of the world around him through firsthand experience with materials. Units can be adapted to all levels.

90.00 Kitchen Physics, ESS, McGraw-Hill, New York, 1967
532 ELE
The student examines liquids--how they form drops and puddles; how they fall and break up; how fast they flow through various sizes of openings; how they heap up, are absorbed, evaporate, mix, and dissolve. He assembles and uses simple equipment, such as a balance which he then modifies for use as a tensiometer.

91.00 *Learning About Nature Through Games*, Musselman, Virginia W., Stackpole Books, Harrisburg, PA, 1967
574.07 MUS
Enjoyment of nature can be taught informally through the use of games which are situations that appeal to the play instinct in the child. An alphabetical index of games and activities as well as an index of games by type is included.

92.00 *Learning About Science Through Games*, Goodrich, Warren, Stackpole Books, Harrisburg, PA, 1964
507 GOO
This book, written for adult leaders and children, introduces recreational activities into sciences other than the natural sciences. The table of contents groups games by subject and gives the setting and number of players.

93.00 *Life Cycles*, SCIS, Rand McNally and Co., Chicago, 1970
574.1 SCI
By studying the life cycles of selected plants and animals, it is possible for pupils to observe the characteristics of living organisms. Pupils plant seeds and observe their germination, growth, and development. Animals such as the frog are observed as they undergo metamorphosis. *Life Cycles* is designed for second grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

94.00 *Life Histories*, EIS, McGraw-Hill, New York, 1967
574.3 LIF
This unit is a study of the different changes that occur in some animals and plants as they pass through various stages of development.

95.00 *Life of Beans and Peas, The*, ESS, McGraw-Hill, New York, 1969
583 ELE
This unit encourages children to plant beans and peas, tend them, and observe them throughout one life cycle and on into a second generation grown from class-produced seeds.

96.00 *Life Processes of Plants*, EIS, McGraw-Hill, New York, 1967
581.1 LIF
In this unit, pupils investigate some of the life processes of green plants. They study the exchange of gases (carbon dioxide and oxygen) which takes place between the plant and its environment.

97.00 *Light*, EIS, McGraw-Hill, New York, 1967
535 LIG
In this unit, pupils investigate light phenomena using light sources, mirrors, and lenses.

98.00 *Light and Shadow*, EIS, McGraw-Hill, New York, 1966
535 LIG
The purpose of this unit is to develop the concepts that light is essential to vision, that light can come from many sources, that different materials transmit light in different ways, that a shadow is formed when an object is in the path of light, and that the size and shape of a shadow can be changed.

99.00 Light and Shadows, ESS, McGraw-Hill, New York, 1968

535 ELE

In exploring the world of light and shadows, both outdoors and indoors, children find new meanings in a number of ordinary objects and phenomena. When children are exploring shadows, they are experimenting with spatial relationships in simple ways.

100.00 Living Laboratory, The, Witherspoon, J.D., and Witherspoon, R.H., Doubleday & Co., New York, 1960

574.028 WIT

This book contains projects and experiments for students and amateur biologists of all ages. It deals with all the major areas in the biological study of living animals and the human body. The authors have introduced each area with an account of its history, practical application, and general significance. The appendices include: How Biologists Name Animals, The Care and Handling of Frogs and Mice, Addresses of Biological Supply Houses, and National Science Fair Regulations for Experiments with Animals.

101.00 Living Things, EIS, McGraw-Hill, New York, 1967

574 LIV

This unit involves the study of animals and plants as the two main groups of living things.

102.00 Living Things, Wailes, James R., Teachers Pub. Corp., Darien, CT, 1964

574 WAI

Activities are keyed to varying abilities. Questions are used in several different ways. At the beginning of each chapter is a list of questions children of different ages might ask. Other questions with answers are included in each activity to help teachers guide students. More questions are included later as open-ended activities. Each chapter concludes with a summary of the main ideas.

103.00 Magnets, EIS, McGraw-Hill, New York, 1967

538 MAG

This unit examines some of the characteristics of magnets and magnetic force. Each pupil carries out his own experiments with his own bar magnets and U magnets.

104.00 Mapping, ESS, McGraw-Hill, New York, 1971

526.8 ELE

This offers activities through which youngsters can learn to describe their environment in terms of symbols. They devise ways to describe locations in words or pictures, to represent three dimensions in two, and to show the relative position and size of objects in a space.

105.00 Mapping, EIS, McGraw-Hill, 1967

526.8 MAP

In this unit, pupils learn to use some of the simpler techniques of mapping: establishing scales, using coordinates, angular measurement, and triangulation.

106.00 Match and Measure, ESS, McGraw-Hill, New York, 1971
510 ELE
This resource book illustrates the many ways in which children can work with measurements as a practical tool in the context of other classroom projects. Its activities include measuring lengths, areas, and volumes; and the approach is applicable to other kinds of measurement as well.

107.00 Mirror Cards, ESS, McGraw-Hill, New York, 1968
516 ELE
The basic problem posed by Mirror Cards is one of matching by means of a mirror, a pattern on one card with a pattern shown on another card. Children enjoy the challenge presented and work ahead on their own, requiring little supervision from the teacher.

108.00 Material Objects, SCIS, Rand McNally and Co., Chicago, 1970
507 SCI
Common objects and special materials provided in the kit are described by their properties. The concepts of material and serial ordering are developed. In the last part of the unit, the children continue to investigate the properties of solids, liquids, and gases. Material Objects is designed for first grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

109.00 Measure and Find Out, Book One, Swartz, C.E., Scott, Foresman & Co.,
502.8 SWA Illinois, 1969
Scientific relationships are shown by the use of measurement. Activities include linear measurement, weight, time, temperature, force, light, magnetic force, and plants. This series is suitable for the intermediate level student.

110.00 Measure and Find Out, Book One, Teacher's Notes, Swartz, C.E., Scott,
502.8 SWA Foresman & Co., Glenview, IL, 1969
Each of the lessons in this series consists of a worksheet to which the student must respond. The lesson is usually self-contained so that after an initial introduction the individual, or in some cases larger groups, can proceed on their own.

111.00 Measure and Find Out, Book Two, Swartz, C.E., Scott, Foresman & Co.,
502.8 SWA Glenview, IL, 1969
Scientific relationships are shown by the use of measurement. The first unit deals with the metric system. Other units include Measuring You, Measuring the Weather, Measuring Light, and Measuring Plants. This series is suitable for the intermediate level student.

112.00 Measure and Find Out, Book Two, Teacher's Notes, Swartz, C.E., Scott
502.8 SWA Foresman & Co., Glenview, IL, 1969
Each of the lessons in this series consists of a worksheet to which the student must respond. The lesson is usually self-contained so that after an initial introduction the individual, or in some cases larger groups, can proceed on their own.

113.00 Measure and Find Out, Book Three, Swartz, C.E., Scott, Foresman & Co.,
502.8 SWA Glenview, IL, 1969
Scientific relationships are shown by the use of measurement. The units are: Some Earth Science, Measuring Electricity, A Dash of Chemistry, Measuring Heat, and Work and Simple Machines. This series is suitable for the intermediate level student.

114.00 Measure and Find Out, Book Three, Teacher's Notes, Swartz, C.E., Scott
502.8 SWA Foresman & Co., Glenview, I[illegible], 1969
Each of the lessons in this series consists of [illegible]ksheet to which the student must respond. The lesson is usually s[illegible]contained so that after an initial introduction the individual, o[illegible] in some cases larger groups, can proceed on their own.

115.00 Microgardening, ESS, McGraw-Hill, New York, 1968
589 ELE
This unit introduces children to the molds--a group of microscopic living things very different from the trees, shrubs, wild flowers, and other plants with which they are familiar.

116.00 Microprojection, Kemp, Floyd, Ken-A-Vision, Kansas City, 1971
578 KEM
Emphasis is placed on ecological material as well as analysis of methods employed by one cell animals in controlling their population.

117.00 Microscope and How to Use It, The, Stelhi, Georg, Sterling Pub. Co.,
578 STE London, 1960
This book is intended to serve as a methodical introduction to microscopy. It introduces the construction and use of the microscope and the auxiliary tools. Beginning with the simplest, it moves gradually and thoroughly through all the technical skills.

118.00 Microscopic Life, EIS, McGraw-Hill, New York, 1967
578 MIC
In this unit, pupils learn to use the microscope and practice some of the simpler but important techniques involved in microscopic investigations.

119.00 Miocene Fossils of Maryland, Vokes, Harold E., Johns Hopkins University,
564 VOK Baltimore, MD, 1957
Illustrations of all of the common species of the larger fossils and at least one representative of the genera that occur less abundantly are included. Those fossils whose study requires microscopic techniques are not included.

120.00 Mobiles, ESS, McGraw-Hill, New York, 1969
531 ELE
A unit for the primary grades that describes very simple ways in which children can experiment with balance by making constructions that are provocative and delightful to look at. It may be presented as an activity that is an end in itself, or it may be incorporated into more systematic explorations involving balancing and weighing.

121.00 Models: Electric and Magnetic Interactions, SCIS, Rand McNally and Co.,
537 SCI Chicago, 1971
The activities in this unit are directed toward increasing understanding of electric and magnetic phenomena through concrete experience and abstract thought. The concept of a scientific model is introduced. Models is designed for sixth grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

122.00 Molds, EIS, McGraw-Hill, New York, 1967
589 MOL
In this unit, pupils learn that molds, which are a common form of plant life, differ from most green plants in that they do not have chlorophyll and lack roots, stems, and leaves. Their mode of reproduction is through spores.

123.00 Mosquitoes, ESS, McGraw-Hill, New York, 1971
595.7 ELE
This resource book is a helpful guide to class activities for individuals or small groups and contains information on raising mosquitoes and ideas for experiments.

124.00 Motion, Dunn, Lois E., Teachers Pub. Corp., Darien, CT, 1964
531 DUN
Activities are keyed to varying abilities. Questions are used in several different ways. At the beginning of each chapter is a list of questions children of different ages might ask. Other questions with answers are included in each activity to help teachers guide students. More questions are included later as open-ended activities. Each chapter concludes with a summary of the main ideas.

125.00 Motion, EIS, McGraw-Hill, New York, 1967
531 MOT
This unit stresses the concept that motion is relative and that position can only be described in reference to the location of another place or thing at a given time.

126.00 Mr. Wizard's 400 Experiments in Science, Herbert, D., and Rucklis, H.,
502.8 HER Book-Lab Inc., New York, 1968
This book is organized into short, four-page chapters, each of which stands on its own dealing with a different topic. Topics are grouped under the headings: Living Things, Liquids and Gases, Energy of Motion, Magnetic and Electrical Energy, and Other Forms of Energy. Explanations are included with the experiments. Suggestions for science projects are included in the back.

127.00 Musical Instrument Recipe Book, ESS, McGraw-Hill, New York, 1971
781.91 ELE
Making musical instruments combines craftsmanship with exploring the physical properties of devices that produce sound. This resource book contains illustrated instructions for making over twenty stringed, wind, and percussion instruments from inexpensive, readily available materials.

128.00 Mystery Powders, ESS, McGraw-Hill, New York, 1967
543 ELE
Activities deal with the properties of ordinary white powders (starch, baking soda, plaster of Paris, granulated sugar, and salt) and the use of indicators in identifying them and detecting their presence in mixtures. The powders are safe for children to handle and taste and are inexpensively obtained from drug, grocery, and hardware stores.

129.00 New Look at Elementary School Science, A, SCIS, Karplus, R., and Thier,
507 KAR H.D., Rand McNally and Co., Chicago, 1967
This book was written to furnish current information about the Science Curriculum Improvement Study to elementary school teachers and to students in teacher training.

130.00 Optics, ESS, McGraw-Hill, New York, 1971
535 ELE
The intent of this unit is to provide opportunities for children to notice and analyze, through direct experiment, many of the interesting properties of light.

131.00 Organisms, SCIS, Rand McNally and Co., Chicago, 1970
574 SCI
Pupils become familiar with some of the requirements for life as they set out seeds and watch the growth of plants. This experience is extended when the class builds aquaria with water plants, fish, and snails. The concept of habitat is developed as plants and animals living outside the classroom are compared with those in the aquaria. Organisms is designed for first grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

132.00 Pattern Blocks, ESS, McGraw-Hill, New York, 1970
516 ELE
This set of 250 flat blocks includes six shapes and colors. Except for the two-inch sides of the trapezoid, all the sides are an inch long. This allows children to build closed as well as open designs and to acquire a feeling for the size and shape relationships among the blocks.

133.00 Peas and Particles, ESS, McGraw-Hill, New York, 1969
511 ELE
This is a unit in which children deal informally with estimation and large numbers in ways that may be new to them. They answer questions--How many? How big? How far away?--not with worksheet or arithmetic-test precision, but as we tend to answer questions ordinarily, with estimates and "educated" guesses.

134.00 Pendulums, ESS, McGraw-Hill, New York, 1969
531 ELE
Pendulums gives children a chance to observe, investigate, and reflect upon the many physical phenomena associated with swinging objects.

134.50 Plant a Tree; resources for the study of trees and other plants, MCPS,
016.582 MON 1974
This book contains history surrounding Arbor Day and activities, including directions for planting seedlings and trees. The outstanding bibliography contains magazine articles, songs, MCPS films, and nonprint media, as well as over 250 library books.

135.00 Plant and Animal Responses, EIS, McGraw-Hill, 1967
574.5 PLA
In this unit, the pupils investigate the responses of pill bugs to light, moisture, and food. They experiment with plants--corn and oat seedlings--to observe responses to gravity and light.

136.00 Plants in Spring, EIS, McGraw-Hill, New York, 1967
581.1 PLA
This unit focuses on various aspects of plant growth and reproduction. Emphasis is placed on giving each child the experience of growing his own or his group's plants from seeds, bulbs, and tubers.

137.00 Pond Water, ESS, McGraw-Hill, New York, 1969
574.5 ELE
Pond Water introduces children to an exciting array of living creatures, invites them to make their own collections on field trips, distinguish their finds through observation and description, and go on to study the tiny animals they have collected.

138.00 Pond Water Cards, ESS, McGraw-Hill, New York, 1969
574.5 ELE
The method cards describe techniques for collecting specimens, making up aquaria, maintaining live specimens, and preparing slides for study under magnification.

139.00 Populations, SCIS, Rand McNally and Co., Chicago, 1972
574 SCI
The observations of separate populations of daphnia and aphids focus attention on the importance of food supply, living space, and reproduction in the increase or decrease in size of a population. The effect of plant-eaters (crickets) on plant populations in terraria is observed. The predator-prey relationship is introduced when chameleons are added to the terraria. When young crickets hatch, reproduction is seen as a means of population survival. Populations is designed for third grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

142.00 Relative Position and Motion, SCIS, Rand McNally and Co., Chicago, 1972
531 SCI
Students use a variety of reference frames to describe the position and motion of objects in their everyday environment. Early in the unit the artificial observer serves as a reference point. Later polar and rectangular coordinates are introduced. Relative Position and Motion designed for fourth grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

143.00 Relativity, SCIS, Rand McNally and Co., Chicago, 1968.
530.1 SCI
Relativity consists of four parts. The first two deal with relative position and the last two with relative motion. In part one reference objects in the environment are used. In part two Mr. O establishes a central reference object. In part three motion relative to Mr. O is introduced. Part four contains more discovery activities. Relativity

is designed for fourth grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

144.00 Rocks and Charts, ESS, McGraw-Hill, New York, 1969
552 ELE
The unit encourages children to look closely at the characteristics of rocks (and other minerals), to establish their own ways of comparing objects, to agree upon useful standards, and to find greater possibilities in their own collections.

145.00 Sand, ESS, McGraw-Hill, New York, 1970
152.1 ELE
During the course of this unit, children explore how sand feels, flows, piles, and slides. They compare sand with dirt, mud, salt, and sugar. They make sand from rocks and try to make rocks from sand. They find ways to sort sand; use it to tell time, count, measure, and weigh; and explore color and texture in the making of sculpture, pictures, and jewelry.

146.00 Science--a process approach (commentary for teachers), Sears, Paul,
507 AME Chairman of Comm., AAAS, U.S., 1968
The book was written as a guide and reference for teachers using Science--a process approach. The Forword and Statement of Purposes and Objectives of Science Education in School tell about the objectives of the program and how and why it was developed. More specific information appears in the sections on Teaching Science--a Process Approach: Some Questions and Answers; the Evaluation; the Basic and Integrated Processes; the Overview of Content; and the Background Papers.

147.00 700 Science Experiments for Everyone, UNESCO, Rev. and enl. edition,
502.8 UNI Doubleday & Co., New York, 1962
Each chapter offers approximately 50 related experiments, with brief, easy-to-follow instructions and clear "how-to" diagrams. Materials needed for each experiment are listed. Some of the chapters are: Plant Study; Animal Study; Rocks, Minerals and Fossils; Astronomy; Air and Air Pressure; Weather; Water; Machines; Forces and Inertia; Sound; Heat; Magnetism; Electricity; Light; The Human Body.

148.00 Science in Your Own Backyard, Cooper, Elizabeth K., Harcourt, Brace &
500.9 COO World, New York, 1958
This book shows the intermediate level student how to explore the soil and rocks; insects, snakes, and other animals; flowers and grasses; the weather; and the stars. Numerous simple and fascinating experiments using easily available materials are described.

149.00 Senior Balancing, ESS, McGraw-Hill, New York, 1970
531 ELE
While actively investigating balancing, children encounter the concepts of the forces present in equilibrium, symmetry, and gravity.

150.00 Sink or Float, ESS, McGraw-Hill, New York, 1971
532 ELE
Children work with various objects that sink or float in tap water, salt water, or cooking oil. They compare wood, metal, and plastic objects; glue wooden cubes together to see how different shapes of the same material float; try to float "sinkers" and sink "floaters."

151.00 Small Things, ESS, McGraw-Hill, New York, 1967
578 ELE
With Small Things students are introduced to the microscopic world, to the instruments needed to make it accessible, and to the appearance and structure of living and nonliving things.

152.00 Solids, Liquids, and Gases, EIS, McGraw-Hill, New York, 1967
530.4 SOL
This unit concerns some of the physical properties of matter in its three phases: solid, liquid, and gas.

153.00 Sound, EIS, McGraw-Hill, New York, 1967
534 SOU
This unit introduces and develops the concept that sound is produced by a vibrating body.

154.00 Sourcebook for Elementary Science, A, 2nd Ed., Hone, Elizabeth B.,
507 HON Joseph, A., and Victor, E., Harcourt, Brace,
Jovanovich, New York, 1971
The authors have included techniques and procedures useful not only for the full range of elementary science classrooms (Grades 1-8) but also for the variety of individual students within these classes. Each of the twenty-four chapters covering the various fields of science includes a list of suggested projects and bibliography.

155.00 Sourcebook for the Biological Sciences, A, Morholt, Evelyn, Brandwein,
574 MOR Paul F., and Joseph, Alexander, Harcourt, Brace
& World, New York, 1966
Section One, Patterns in the Use of Laboratory Techniques and Procedures, contains ideas for the designing and conducting of courses in biology that can be used with any text or course of study. The fourteen chapters in Section Two, Techniques in the Laboratory and Classroom, are designed to meet the needs of students at all levels as well as cover materials used. The descriptions are complete and illustrated with numerous drawings and photographs. A bibliography appears at the end of each chapter.

156.00 Sourcebook for the Physical Sciences, A, Joseph, Alexander, Brandwein,
500.2 JOS Paul F., et al., Harcourt, Brace & World, New
York, 1961
Following an introduction devoted to patterns in the use of laboratory techniques and procedures, are sections on physical science, chemistry, and physics. These sections contain a multitude of demonstrations and laboratory procedures as well as numerous suggestions for experiments and projects. Each chapter includes a list of free or low-cost materials and a bibliography.

157.00 Space, Costa, A.L., and Woodburn, J.H., Teachers Pub. Corp., Darien, CT, 1964
523 COS
Activities are keyed to varying abilities. Questions are used in several different ways. At the beginning of each chapter is a list of questions children of different ages might ask. Other questions with answers are included in each activity to help teachers guide students. More questions are included later as open-ended activities. Each chapter concludes with a summary of the main ideas.

158.00 Spinning Tables, ESS, McGraw-Hill, New York, 1971
531 ELE
Children are familiar with motion in a straight line. A spinning table is a simple, manageable piece of equipment with which children can explore the paradoxical behavior of things which move in circles.

159.00 Starting From Seeds, ESS, McGraw-Hill, New York, 1971
582 ELE
In this unit, children are given seeds and vermiculite and containers in which to grow them.

160.00 Stream Tables, ESS, McGraw-Hill, New York, 1971
551.3 ELE
Stream Tables offers activities that children can carry on in the classroom to study such events as the behavior of streams, erosion and soil conservation problems, and the action of waves on beaches.

161.00 Structures, ESS, McGraw-Hill, New York, 1970
721 ELE
The materials in this unit were chosen because they present all kinds of problems in structural design.

162.00 Subsystems and Variables, SCIS, Rand McNally and Co., Chicago, 1970
507 SCI
The subsystems concept is introduced to give students a grouping of objects between a single object and an entire system. Students use separation techniques with solid and liquid materials. Conservation of matter is implicit. Working with the whirly bird, students investigate variables. Subsystems and Variables is designed for fifth grade and is part of the inquiry-centered, conceptually-structured SCIS curriculum.

163.00 Tangrams, ESS, McGraw-Hill, New York, 1968
516 ELE
The tangram is a fascinating geometric puzzle consisting of seven pieces dissected from a square. This adaptation includes a set of problem cards that begin with smaller groups of the seven-piece set in order to help the children develop skill in dealing with basic geometric relationships before they confront more complex problems.

164.00 Teacher's Resource Book for Science in the Primary Grades, de Lourdes, R.S.M., Sister Mary, et al., McGraw-Hill, New York, 1967
507 DEL
Part One aims at examining the problems most pertinent to teachers of primary children. The authors believe it is as important for the

teacher to understand the objectives and organization of the science program as a whole as to master a particular lesson. Materials are outlined on three levels in the seven areas: Plants; Animals; Air, Water, and Weather; Astronomy and Earth Science; Energy, Motion, and Sound; Electricity and Magnetism; Machines. Each section contains science concepts and suggested experiences and activities.

165.00 Teaching Science With Everyday Things, Schmidt, V.E., and Rockcastle,
507 SCH V.N., McGraw-Hill, New York, 1968
This book, designed to be of practical help to elementary teachers and college students who are preparing to teach, contains a multitude of pupil activities using everyday materials. The importance of firsthand experiences with real things as the foundation of all learning in science is emphasized. Each chapter has a one-page discussion of some aspect of science teaching. Only one of the twelve chapters deals with living things.

166.00 Time, EIS, McGraw-Hill, New York, 1967
529 TIM
This unit develops the idea that time itself has no beginning or end, but that it can be measured by the regular repetitions in the positions of the sun and the earth relative to each other.

167.00 Tips and Tricks in Outdoor Education, Swan, Malcolm, Ed., The Interstate
371.3 SWA Printers & Publishers, Inc., Danville, IL, 1970
Plans for the study of animals, ecology, geology and soils, magnetic compasses, measurement and mapping, plants, water, and weather as well as creative expression and nature arts and crafts are provided.

168.00 Tracks, ESS, McGraw-Hill, New York, 1971
591 ELE
For the child, there is much reward in unraveling the events that shaped a track: the animal that made it; the direction it was going; whether it was moving quickly or slowly; how long ago it lived; and many, many other discoveries.

169.00 Unbalanced Forces, EIS, McGraw-Hill, New York, 1967
531 UNB
In this unit, pupils investigate several factors which help determine the distance an object will travel when it is subjected to unbalanced forces: the direction and magnitude of the push or pull, the weight of the object, and the surface conditions.

170.00 Universe, The, EIS, McGraw-Hill, New York, 1967
523.1 UNI
In this unit pupils learn some of the ways in which man has accumulated knowledge of the universe.

171.00 Water Flow, ESS, McGraw-Hill, New York, 1971
532 ELE
This unit takes advantage of the natural appeal of water play to enable children to improve their insight into water flow in closed systems.

172.00 Weather, EIS, McGraw-Hill, New York, 1967
551.6 WEA
This unit develops the understanding that weather factors can be observed qualitatively (sunny or rainy) and measured quantitatively (inches of rain, degrees of heat).

173.00 Weeple People, Gillespie, D. Craig, ESS, McGraw-Hill, New York, 1972
153.2 GIL
Weeples are Wenks, Boings, Fraxes, Toopeds, and other delightfully strange and friendly little characters, illustrated in full color, that help young people learn to identify attributes of particular groups. With whimsey and playful imagination, children are induced to think and create for themselves by observing and conceptualizing. Throughout, children are invited to participate--creating poems, games, songs, etc. about Weeple People drawings which will indicate that they understand the concepts presented.

174.00 What's Up There? (Blue), NASA, U.S. Government Printing Office, Washington, D.C., 1964
513 UNI
This source book in space oriented mathematics for Grades 5-8 was prepared from materials furnished by the National Aeronautics and Space Administration. A glossary and bibliography are included.

175.00 What's Up There? (Yellow), NASA, U.S. Government Printing Office, Washington, D.C., 1964
513 UNI
The teacher's edition of a sourcebook in space oriented mathematics for Grades 5-8 gives answers to questions and problems found in What's Up There? (Blue). A glossary and bibliography are included.

176.00 Where is the Moon?, ESS, McGraw-Hill, New York, 1968
523 ELE
The objective of this unit is to give children an opportunity to see the sky for themselves, to see it as a place where they can slowly become at home.

177.00 Where was the Moon?, ESS, McGraw-Hill, New York, 1968
523 ELE
A student booklet which provides a daily picture record of observations of the moon at the same time of day during a one-month period.

178.00 Whistles and Strings, ESS, McGraw-Hill, New York, 1971
534 ELE
Working with materials that produce sounds of definite pitch--such as stiff and flexible plastic tubing, straws, and different kinds of string--children explore the relationship between objects and the sounds they make.

179.00 Young Animals, EIS, McGraw-Hill, New York, 1967
591.3 YOU
This unit develops the understanding that many animal offspring resemble their parents but are smaller.